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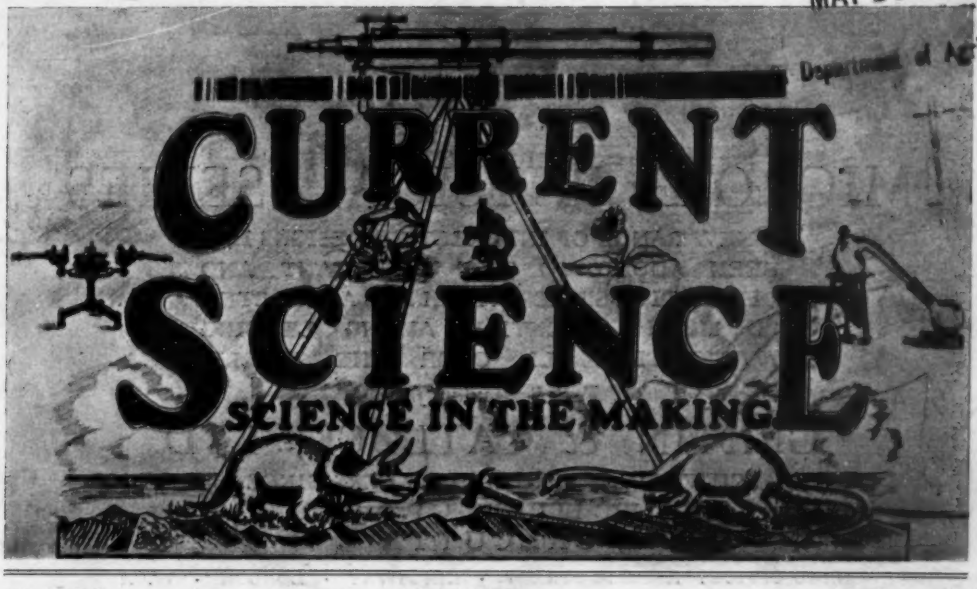

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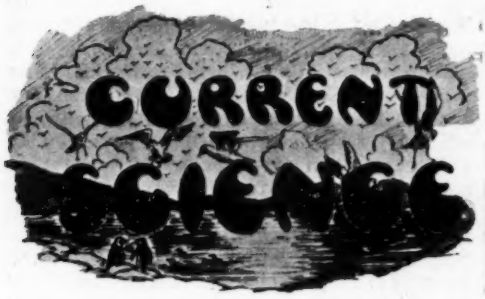

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The Inter-University Board.

AT the Quinquennial Conference of the representatives of Universities recently held at Delhi, a most notable pronouncement on the functions of the new type of Universities under the reformed constitution, was made by H. E. The Viceroy in his opening address, and perhaps the most important educational subject discussed by the delegates at their sessions was the desirability of instituting the vernaculars as a medium of instruction and examination in the non-language branches of knowledge in the pre-university course. A suggestion is reported to have been made quite seriously by one of the delegates representing one of the S. Indian Universities, that even the higher education in science and humanities should be given in the vernaculars. Almost immediately after the Conference concluded its sittings, H. H. The Gaekwar of Baroda who presided at the Hindi Sammelan which also met at Delhi spoke in favour of adopting Hindi as the *lingua franca* for India and Sanskrit as a common script for the whole country.

It seems to us that there is a wide difference between the development of one's own vernacular and the adoption of Hindi as a common language for the whole of India and we are fully aware of the fact that language barriers impose serious obstacles in the way of attaining national solidarity. We are disposed to think that the failure of the World Economic Conference which was attended by representatives of nearly sixty-six nations who assembled in London, some time ago, is largely to be attributed to the inability of the delegates to understand each other's sentiments without the assistance of interpreters. Each delegate treated the world problem from the standpoint of his country and offered proposals for its solution in his own language. It is obvious that narrow parochialism of language and outlook must surely militate against unanimity of agreement being reached in arranging for a common policy or the treating of the world economic question as an organic unit. In a sense, India is like the powers participating in the World Economic Conference and the very causes which led to the collapse of the latter, also operate against the attainment of the national aspirations of the former. In order to produce linguistic unity among the Indian people,

H. H. The Gaekwar has suggested the following solution:

"For imperial affairs English, for the higher cultural life English and Sanskrit, for national life Hindi, for home-life our vernaculars—such is, I think, India's immediate path."

In another section of his speech, His Highness while criticising some South Indian leaders advocating English as the common speech for all India, is reported to have said:

"We have, in other words, to imagine every Indian as trilingual, with one tongue for his home and social life, and another, English,—totally unrelated,— for his public and interprovincial communications. To these he must add Sanskrit if he is a Hindu, Arabic or Persian if he is a Muslim. These are needed if he is not to be alienated from his own literary heritage. Thus with his every-day mind working in, say Marathi or Bengali, he must have an English lobe and a Sanskrit or Persian lobe to his brain for his pursuit of his eastern and western culture."

We are afraid that the constructive proposals of H. H. which we have already quoted tend rather to increase than to diminish the number of lobes against which he complains. If the criticism is true that the present bilingual system of education in India deprives its recipients of the ability to think clearly in either of the languages, then if we were to multiply the languages in accordance with His Highness's suggestion, thinking will perhaps come to be regarded in India as an idle waste of thought; much less would such a procedure confer on young men the power to enrich their literature in any one of the languages enumerated by His Highness. His suggestion, however, is capable of simplification without injuring its great merits.

The history of the vernaculars in the Indian educational system is interesting, and recently the whole problem has undergone a complete change and has assumed a new complexion which the earlier advocates of vernaculars could not have pictured to themselves. It may be remembered that the abolition of Persian from the courts in 1837 and the freedom conferred on the press gave a great impetus to vernacular education. In the subsequent year Sir Charles E. Treveleyan wrote: "We are deeply sensible of the importance of encouraging the cultivation of the vernacular languages and we conceive the formation of a vernacular literature to be the ultimate object to which all our efforts must be directed." Almost every educationalist or administrator who has spoken or written on educational subjects since that date has referred to the need of cultivating the local vernaculars so that they may be used as a means of conveying to the masses of population the advantages of western scientific knowledge and culture; but in 1904, the Government of India discovered that in the intensive pursuit of acquiring efficiency in English, the Indian pupils had neglected their vernaculars almost to a degree. In reviewing the causes which led to the neglect, the Government of India in their Resolution of 1904 suggested the employment of the vernaculars as a medium of instruction up to the age of thirteen. This question of the medium of instruction was again raised by Mr. Rama Rayaningar (Raja of Panagal) in the form of a motion in the Imperial Legislative Council in 1915. Thus the general review of the causes which led to the vernaculars being neglected, introduced into education a totally different problem, *viz.*, the medium of instruction and since 1915, other considerations than those of a purely educational character have tended to render the whole subject exceedingly complex.

The justification for introducing the vernacular of the pupils as the medium of instruction up to a certain age is now recognised beyond dispute but the argument that it is the only medium by which education can progress in India even in the higher grades is not borne out by the testimony of earlier educationalists. The Public Education Committee of 1831, of which Sir Charles Treveleyan was a member, in reviewing the results of education, have recorded that "a command of the English language and a familiarity with its literature and science have been acquired by the pupils to an extent rarely equalled by any schools in Europe. A taste for English has been widely disseminated." Seven years after the publication of this report, Sir Charles Treveleyan commenting on the capacity of Bengalee children for learning English, says that they "seem to have their faculties developed sooner and to be quicker and more self-possessed than English children. Even when the language of instruction is English, the English have no advantage over their native class-fellows. As far as capability of acquiring knowledge is concerned the native mind leaves nothing to be desired. The faculty of learning languages is particularly powerful in it." The allegation that the use of a foreign language as the medium of instruction in Indian schools and colleges must result in the "mental degradation" of

the pupils, is not applicable to the present generation of scholars, scientists, philosophers, public leaders and economists nor even to the critics of the educational system.

The educational plan as devised by the Resolution of the Government of Lord William Bentinck was to educate the upper and middle classes first and through them, the great masses of people and for this purpose, successive governments emphasised the cultivation, refinement and enrichment of the vernaculars. The modern reformers of education desire to reach the masses of the people directly by making their mother tongue the medium of instruction, and undoubtedly this is a measure of reform which is bound to have great influence on the social and ideal life of the people. Among the reformers who advocate a change in the medium of instruction we may recognise three distinct schools of thinkers. A large section of people most sincerely feel that the substitution of Hindi as the medium of instruction in all grades of education is a reform urgently called for and they certainly have very weighty arguments in favour of their proposals. But under this scheme the rural population inhabiting the non-Hindi provinces will continue to suffer from the very disabilities which English as the medium of instruction has imposed. The second school of thinkers, who see in the development of the local vernaculars the mechanism for improving the social and economic system of the people, support the adoption of the language of the provinces as the medium of instruction only up to the high school standard and in accordance with this recommendation, the local governments, through their educational departments, have accorded permission to the high schools to teach non-language subjects through the vernaculars. A small third section of educationalists hold the opinion that, while English should be permitted to remain as the medium of instruction in the high schools, every encouragement should be provided for the cultivation of a sound and efficient vernacular prose literature and the infusion into it of the elements of modern culture.

Within comparatively recent years the major Indian vernaculars have developed to a sufficiently high pitch to be used as the medium of instruction in general subjects at least up to the pre-university course, but the competing claims of any one of them to be selected as the exclusive language for the whole of India will raise difficulties of a non-educational character. Every student of contemporary educational thought, knows that there is an extensive and authoritative body of literature on the subject of the following resolution which the Universities Conference discussed at their last session:

"While this Conference favours the extension of the course of study for Degree Examinations to over three years instead of as at present, at the same time it is strongly of opinion that it would not be desirable to add one more year to the ordinary pass degree course, or to reduce the period of study for Degree Examination from four years after the high school stage to three, unless and until the standard of instruction in secondary schools is materially improved and that in order that the period of study for the pass degree should be at least three years, the total period of instruction of the pupil should not be increased but should be divided into definite stages of primary and middle in which stage education in non-language subjects should be entirely through vernacular wherever practicable and university education covering five (or four), four (or five) and at least three years respectively, there being a formal examination at the end of each stage, only thus avoiding abuse of too many formal examinations; that until this reorganisation is effected the total period of study of the pass degree should not be reduced to three years after instruction from the present four years."

It will be noticed that the recommendation of the Conference on the adoption of vernaculars as the medium of instruction makes it optional and other topics are treated in a conditional way.

A great part of our economic miseries arises from the faulty system of education which practically trains young men for unemployment, and almost all our political troubles are to be traced to the language barriers which separate the governing classes from the masses of population. It seems to us that in India the question of the medium of instruction extends beyond the frontiers of education; and if this is admitted, then a formula must be invented to remove the language anomaly which divides the government and the people. Recent experiences of the Government of India must have taught them the utter futility of the political doctrine first promulgated by the Court of Directors, that the masses of a vast sub-continent could be governed through "interpreters" and it is only natural that some of them should have now changed their calling. If the treatise submitted by Mr. Charles Grant to the Court of Directors had stipulated that every British sojourner in India for whatever purpose, should possess a working knowledge of one of the major languages of the

province and that his children should be educated along with those of Indian people, or if such a policy had formed one of the articles of the Great Proclamation, India would have been assured of two things. Firstly, the ruling classes would have established a language kinship with the people and secondly, Indian schools and colleges would have occupied the status now enjoyed by the Colonial institutions. It seems to us therefore that the question of the medium of instruction in schools and colleges is at bottom a question of the medium of language through which the government of the Indian people is to be administered and that the smoothness and stability of this administration must largely depend upon the degree of cordiality which a common language can promote.

If we accept a broad conception of the citizenship of the British Empire and admit that the British rulers in India form an integral part of its larger life then all educational reforms must bear some reference to the children of the European residents in India. The omission of this in the past has emphasised the difference now separating the governing classes from the Indian people and may possibly have contributed to much of the unhappy misunderstanding. If the Government of India were to arrange to educate the children of their officers in Indian educational institutions, along with children of the Indian people, than which nothing can be more desirable and natural, a great impetus would thereby be given to the progress of Indian education and the status of Indian schools and colleges. Is it not legitimate to demand that the children of the ruling classes, European as well as Indian, be trained along with those of the masses of population whose interests, needs, aspirations and difficulties they will in later life need to watch and study at close quarters and discuss in the vernaculars of the district when placed in positions of trust and authority over them? All Governments which choose to be isolated from the people by language barriers, and which base their administrative acts and measures on the testimony of interpreters, must inevitably live in an atmosphere of unreality. Racial exclusion must breed the suspicion which is the parent of all mischief, and we feel that the scheme of education that we suggest may produce happier results than any educational reform has so far conceived or attempted to produce.

The medium of instruction is intimately associated with the problem of employment. Whatever may be the medium ultimately adopted by Indian educationalists and statesmen, we should not ignore the fact that the recipients of such education must become fully qualified for all the rights and privileges of citizenship of the British Empire. Further, the medium must not impose a handicap on enterprising young men seeking to earn a livelihood in other parts of the British Empire. Keeping in view this aim, we shall have to devise a scheme of education in which the medium of instruction will bring the provinces nearer to each other, and the Government and the general population into closer bonds of mutual appreciation, sympathy and common endeavour; so that eventually the existing linguistic, social and racial barriers are removed. In India no system of education which does not emphasise the principle that the governing classes, no less than the different peoples should be Indians in thought, action and being, can be psychologically correct or practically sound.

Manifestly, the cardinal feature of such a system of education must be that every one in India ought to be able to speak one major language fluently and idiomatically besides his own. This implies that the ruling classes must acquire a deep knowledge of either Hindi, Bengali, Urdu, Marathi or one of the Dravidian languages to enable them to dispense with the assistance of interpreters in discharging their executive functions, administering justice in the countryside or discussing with the people the intentions and purposes of the Government acts and legislative measures. In future reforms of educational organisation provision must therefore be made for the training of young British Officers no matter to what branch of service they may belong as also their children and those of other European settlers in India, in one of the major provincial languages at least up to the intermediate standard.

The rural population, on the other hand, must have facilities, according to our scheme, of completing education at least up to the secondary standard in completely equipped vernacular high schools. And once the British administrators have realised the importance of learning the Indian languages more intimately than their "official tests" then what should be the medium of instruction for the upper and middle classes of

Indian children is clear. We have no hesitation in saying that English should be the medium in the Universities and Hindi or preferably Urdu in the High Schools. To us it seems that, if reduced to this simple form, the suggestions of the Gaekwar of Baroda must before long become the declared object of the educational policy of the Indian people themselves. It is almost impossible to imagine that the rapidly growing millions of India can ever be English-speaking. But it is not too much to suppose that the British administrators can become vernacular-speaking.

We are aware that this ideal must be somewhat remote for various reasons, the chief of which is that languages are among the most cherished vested interests of the people. We hope that it may nevertheless be fulfilled soon, since it calls for no sacrifice, but only for additional achievement. We have to realise that even in the ordinary affairs of life we find it difficult to become friendly with those with whom we cannot converse in their own language, whose habits and manners we have no means of understanding and whose literature we cannot read. The removal of such barriers must produce an atmosphere fostering friendship and peace, and will dissipate the misunderstanding and unhappy relations engendered by ignorance. We urge that in a case where the interests of a vast Empire are involved no effort which tends to consolidate the Government and people into an organic unit should be considered too great or beyond the resources of wise and far-seeing statesmanship.

Flow Beneath Masonry Works Founded on Sands.

By Dr. E. McKenzie Taylor, M.B.E., Ph.D., D.Sc., F.I.C.,
Director, Irrigation Research, Punjab, Lahore.

A COMMON characteristic of the Headworks of a number of canal systems in the Punjab and elsewhere in India is the construction of a weir across the river and a system of gates regulating the supply to the canal. The weirs that have been constructed usually rest on the sand beds of rivers and their stability largely depends on the flow of water under the weir and the pressure on the work due to the head of the water above the weir. Studies of the conditions of flow under the weir and of the pressures involved are therefore of the greatest importance both in connection with the design and stability of the work. A series of investigations on the above subjects has been in progress at the Irrigation Research Institute, Punjab, during the past year and although these are not by any means complete, the results are of interest as they indicate that theories of design which have been previously accepted are incorrect and that problems that were not suspected in the past require solution. A brief account of the work that has been done and the results obtained will be given.

The first step in these investigations was to devise a method of tracing the flow under a model of a work. After a number of trials the following was the method adopted. A tank was constructed of the following dimensions: $3' 10'' \times 2' 6'' \times 2''$. The tank was partially filled with a graded sand and the model placed in position on the sand. A solution of potassium chromate was then placed in the tank and after a certain period, usually six hours, the sand had become completely saturated with this solution. Upstream of the work a series of tap funnels was placed in position from which it was desired to trace the flow. The tap funnels contained solutions of silver nitrate which on entering the sand reacted with the potassium chromate along the lines of flow and so traced the lines of flow from the series of points.

The steel back of the tank carried a large number of pressure points which were inserted in the sand. The pressure points communicated with a series of manometer tubes and so the pressures under the work could be determined at the same time as the streamlines were being traced. The series of models investigated commenced with the simple forms of impervious floor and a sheet pile. Later more complicated combinations of these structures were investigated.

Fig. 1 shows the streamlines traced under a model of an impervious floor protected by upstream and downstream aprons and upstream and downstream sheet piles.

In the space available it is not possible to give the data on which the conclusions have been based nor is it possible to discuss fully the differences between formerly accepted views and the conclusions to be drawn from these investigations.

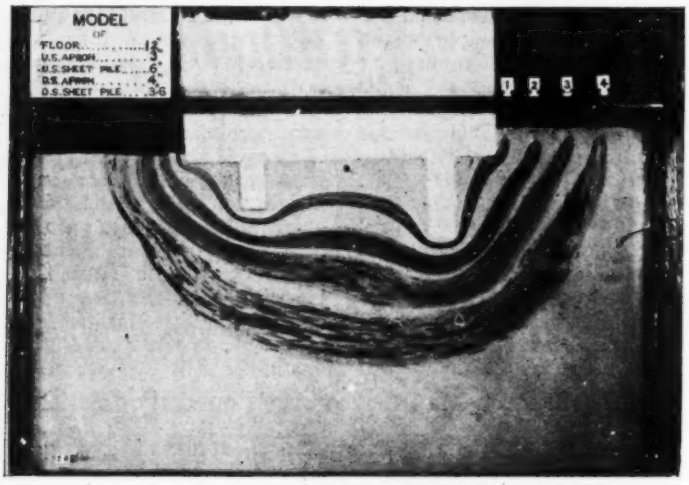

Fig. 1.

Until these investigations had been undertaken, very little data was available upon which theories of flow under a weir could be based. In fact, the accepted views were more in the nature of hypotheses than theories. The main hypothesis that had been accepted by Engineers was that of Bligh which can be stated as follows:—

"The main determining factor in the stability of the sand is the length of percolation or so-called 'Creep'. If an impervious line of sheet piles be inserted below the floor the line of creep may be measured down one side of the vertical obstruction and up the other side. The added length of creep will then be twice the length of the piling."

A further hypothesis regarding the flow is that due to Forchheimer. From a theoretical treatment of this subject he deduces that the flow under a floor should be in the form of a series of semi-ellipses symmetrical with reference to the floor. Since the streamlines cut the equi-pressure lines orthogonally, it follows from this that the pressure distribution should also be symmetrical with reference to the model. The results of the present investigation have shown that the creep which was imagined to take place by Bligh is not existent. Instead of the flow following the profile of the work it follows a series of curves determined firstly by the profile and secondly by the nature of the material, such as clay bands which may underlie the work at some distance from the surface. In any model composed of a floor and a system of sheet piles there appear to be two divisions occurring in the flow nearest the work. The first of these divisions is the major line of flow, the second is the diffused flow of very low velocity situated between the line of major flow and the work. One of the main effects of a system of sheet piles is to break up the flow into these two portions so that the velocity of flow near the work is very low and, hence, the work becomes stable from this point of view. The most stable form of work appears to be that illustrated in Fig. 1. The least stable form so far investigated appears to be an impervious floor protected by an upstream sheet pile. In this latter case there was a concentration of flow at the downstream end of the work which leads to instability owing to the velocity of the exit of the water being sufficiently high to cause the blowing of sand.

Possibly of greater importance than the actual flow of water under the work are the pressures under the floor. So far the investigation of the pressures has been mainly confined to those existing on a simple impervious floor. The results have raised a number of points not previously suspected and until the mathematical analysis of the results has enabled a theory to be put forward which covers the flow under these simple conditions it seems useless to investigate more complicated forms.

Up to the present time the examination of the pressure observations under a simple floor have led to the following conclusions:–

(1) The flow under a simple impervious floor is a series of semi-ellipses.

(2) The ellipses are not symmetrical with reference to the geometrical centre of the model. This fact invalidates the theoretical treatment of Forchheimer.

(3) The equi-pressure lines are not symmetrically distributed with reference to the geometrical centre of the model. They appear to be symmetrical with reference to the equi-pressure lines representing approximately 44 per cent. loss in head. This is again not in accordance with Forchheimer's deductions. Fig. 2 shows the type of pressure distribution observed.

(4) There appears to be a relatively large loss in pressure when the water enters the sand upstream of the model.

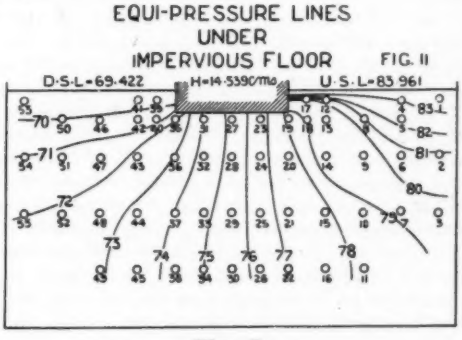

Fig. 2.

It is impossible at this stage to give a complete mathematical treatment of these results. Further experiments are now in progress with the object of studying intensively the pressure variations at critical points under the model. Until these results are available the conclusions already set forth cannot be amplified.

Although this work has only been in progress for about six months it has already found applications to engineering works. The first work to be studied was in connection with the repairs and reconstruction of Khanki Weir, the Head-works of the Lower Chenab Canal, Punjab. The first repair undertaken was the driving of sheet piles at the upstream end of the impervious floor in certain bays. From a study of a model of this construction it was forecast that the bays which had been so treated were in a less stable condition than they were originally before the repairs had been effected. Such proved to be the case, as portions of the floors of Bays Nos. 3 and 4 were damaged during the Kharif Season of 1933 shortly after the forecast had been made. During the cold weather of 1933-34, further reconstruction of the weir was undertaken and at the request of the Chief Engineer models were examined to determine the effects of the proposed measures.

It was shown that the proposals would result in a low velocity of flow in contact with the work but that owing to the presence of cavities under the upstream portions of the work the Hydraulic Gradient would be very steep in this region. The upstream portion of the work would, therefore, tend to be unstable.

In this connection the effect of the pressure relief pipes through the floor, which are a common feature of some works was also investigated. The pressure relief pipe normally installed just passes through the floor. It was shown that pressure relief pipes of this type resulted in the removal of sand from under the work resulting in the formation of the cavities which endangered the stability of the floor and was particularly dangerous because the damage was not open to inspection. In continuation of this investigation the effect of a tube-well, the strainer portion of which was situated some considerable distance beneath the floor, was examined. It was shown that the tube-well effectively relieved the pressure without endangering the stability of the sand. Tube-wells are now being installed in the floor of Khanki Weir where damage may occur through the presence of springs.

In the foregoing account an attempt has been made to indicate the nature of the new developments which are taking place in the

study of one aspect of hydraulics as applied to engineering works. The study at present is very incomplete but its importance is shown by the fact that the results have already found practical application at this early stage of the investigations.

The Occurrence of Crossing over in *Nicotiana* Species Hybrids.

By Mr. Dontcho Kostoff.

(*Academy of Sciences of U.S.S.R. Genetic Institution, Leningrad, U.S.S.R.*)

NUMEROUS trigenomal species hybrids were produced by crossing the F_1-hybrids with a third species or with the parental forms. They offer a very rich cytogenetic material which will be here considered in connection with the exchange of parts between the chromatids of the presumably homologous chromosomes of the species crossed.

The first meiotic division in *Nicotiana* is the reductional division. The univalent chromosomes in the hybrids and in the haploids are distributed at random to the two poles during the first meiotic division and divide during the second one. Exceptions, *i.e.*, division of univalent chromosomes during the first meiosis, occur so rarely that they can be neglected. We have observed such only in the haploid *N. Langsdorffii* (one chromosome has divided in 0·1% of the pollen mother cells) and in the hybrid *N. tabacum* ($n=24$) × *N. glauca* ($n=12$), in the latter, the dividing chromosomes being less frequent (Kostoff 1929, 1930).

In a great many *Nicotiana* species hybrids gametes are formed with the somatic number of chromosomes (unreduced) originating from restitution nuclei (Rosenberg's term). Some of the lagging chromosomes on the spindle in the hybrids do not succeed in reaching the poles during the I meiosis and form a bridge between the two poles, so that all chromosomes (somatic number) undergo interkinesis altogether forming one restitution nucleus. Second divisions with only one metaphase having the Somatic chromosome number of the plant have been often observed in the hybrids where restitution nuclei are formed at the end of the first division. The number of such metaphases is approximately as high as the number of the dyads formed. The number of the large pollen grains formed is about two times greater than the number of the dyads observed. Formation of equal dyads following fusion of both spindles during the second division has been very rarely observed. (This abnormality in meiosis leads to the same result as the formation of restitution nuclei.) Therefore the unreduced gametes formed during the meiosis in *Nicotiana* species hybrids usually result following non-occurrence of the reduction division.

The hybrid *N. glauca* ($n=12$) × *N. Langsdorffii* ($n=g$) represents one of the best examples in this respect. In this hybrid numerous unreduced gametes are formed following non-occurrence of the reduction division. The chromosomes of *N. Langsdorffii* conjugate with 9 chromosomes of *N. glauca* so that 12 chromosomes (9^2+3^1) have been usually observed during the first metaphase. The bivalent chromosomes disjoin during the I anaphase but the separation is often very much retarded so that restitution nuclei are formed, the chromosomes undergoing interkinesis in one group. Following such an interkinesis all chromosomes (12–*glauca*+9–*Langsdorffii*=21) appear in one group of 21 during the second division, *i.e.*, second metaphase with one spindle and one metaphasal plate with 21 chromosomes is formed. Then the equational division follows, so that dyads (instead of tetrads) are formed, each one having 9–*Langsdorffii* chromosomes and 12–*glauca* chromosomes or altogether 21 chromosomes. These chromosomes have been formed as chromatids during the prophasal stage of the I meiotic division. If there was no exchange of segments (parts) between the conjugating *glauca* and *Langsdorffii* chromosomes during the meiosis, the unreduced gametes thus formed should be identical, *i.e.*, they should have the same genetical constitution. If there was an exchange (or exchanges) of parts of *glauca* and *Langsdorffii* chromosomes, the unreduced gametes formed should not be genetically identical. They should differ one from the other by a series of genes. Finally, if there was an exchange (or exchanges) of parts between the chromosomes (but not between the chromatids) of the parental species the unreduced gametes of one dyad should be identical, but the

unreduced gametes of a whole hybrid should not be identical. They should differ by a series of genes.

We can easily find out whether the unreduced gametes produced by a hybrid are identical or different when we cross the hybrid back to the parental species or to a third species, provided that the parental forms or the third species, used in such a crossing are homozygous. If uniform trigenomal hybrids are produced from such a cross, the unreduced gametes formed in the F_1-hybrid are identical, if the trigenomal hybrids thus produced are not uniform, the unreduced gametes are genetically different.

In testing the uniformity of the unreduced gametes formed in *Nicotiana* species hybrids, we crossed the latter with homozygous parental forms or with a third homozygous species. We separated the trigenomal hybrids from the chromosomal aberrants among the offspring produced by detailed cytological investigations. Some of those that contribute definite data for the problem here investigated will be considered.

1. From the cross F_1 (*glauca* × *Langsdorffii*) × *Langsdorffii* 32 trigenomal hybrids with 30 chromosomes were produced, *i.e.*, 21 chromosomes (12+9) from the unreduced gametes of F_1-hybrid and 9 from the paternal plant *N. Langsdorffii*. Eleven of the trigenomal plants differed morphologically very distinctly from the other 21 plants, the latter being approximately uniform. These 11 plants differed in various ways from each other and from the other 21 in respect to several characters, as the shape and the size of the leaves and flowers, the length of the styles, the colour of the pollen, the colour of the flowers, the growth potency, the length of the vegetation period, etc. Some had two outstanding characters, others had three or four, etc.

2. Some of the plants of the trigenomal triple hybrids (*tabacum* $n=24$ × *sylvestris*, $n=12$) × *Rusbyi*, $n=12$, with 48 somatic chromosomes that were recently produced, also differed. It should be mentioned here that the chromosomes of *sylvestris* have a very great affinity to *tabacum* chromosomes and usually 24 chromosomes (12^2+12^1) have been seen in the plates of the first metaphases.

3. Each one of the trigenomal triple hybrids with 48 somatic chromosomes produced by crossing the hybrid *N. tabacum* ($n=24$) × *N. tomentosa* ($n=12$) with *N. Rusbyi* ($n=12$) has one genom from *tabacum*, one from *tomentosa* and one from *Rusbyi*, nevertheless they differed morphologically. The 12 *tomentosa* chromosomes conjugate readily with 12 of the 24–*tabacum* chromosomes in the F_1-hybrids.

4. Some of the trigenomal plants with 48 somatic chromosomes produced by crossing the hybrid *N. tabacum* × *N. tomentosa* back with *N. tomentosa* also differed morphologically.

5. There were some morphological differences between the trigenomal back crosses produced by crossing *N. rustica* ($n=24$) × (*rustica* × *paniculata*, $n=12$), (*rustica* × *paniculata*) × *paniculata*, and (*rustica* × *paniculata*) × *rustica*...It must be here also mentioned that the chromosomes of *N. paniculata* conjugate readily with the chromosomes of *N. rustica*.

6. Some of the differences observed amongst the trigenomal triple hybrids *tabacum* × (*sylvestris* × *Rusbyi*) may belong to the same category, but perhaps not all of them, because we found conjugations only between a few of *sylvestris* and *Rusbyi* chromosomes; most frequently, however, univalents have been observed during the metaphase of the meiotic division. Other factors that are probably involved in the processes responsible for the polymorphism of the trigenomal triple hybrid *tabacum* × *sylvestris* × *Rusbyi* will be discussed elsewhere.

We shall mention once more that in all species crosses here reported we have used species morphologically uniform (giving uniform progenies) with which we have worked during the last 8 years.

The differences observed in the trigenomal hybrids of 2, 3, 4, 5 and 6 are like those discussed in 1, *i.e.*, involving not single characters but several.

We shall also mention here that the three plants (*tabacum* × *sylvestris*) × *tomentosa* produced recently by Eghis differed morphologically. He did not use F_1 (*tabacum* × *sylvestris*) for maternal plant but an amphydiploid *tabacum* × *sylvestris*. Having in mind the very great affinity between the *sylvestris* and *tabacum* chromosomes, there is to be expected a formation of tetravalent chromosomes in the amphydiploid *tabacum* × *sylvestris* during the meiosis as this occurs in the amphidiploid *rustica* × *paniculata* studied recently, therefore an association and crossing over between the *tabacum* and *sylvestris* chromosomes in the amphidiploid *tabacum* × *sylvestris* is not excluded. But when we consider that in

separation of the four members of a tetravalent chromosome TTss (where T=*tabacum* chromosomes and s=*sylvestris* chromosomes) there may be two possibilities (supposing that T=T and s+s genetically), namely: Ts+Ts and TT+ss as these seem to occur in the *rustica*×*paniculata* amphidiploid [rrpp=(1) rr+pp, (2) rs+rs], then the differences in the gametes formed by the amphidiploids can be due not only to crossing over, but to the differences in whole chromosomes too.

The above examples show that the unreduced gametes formed in the F_1-species hybrids are not identical and their genetical differences can be most satisfactorily explained by postulating the occurrence of crossing over between the chromatids of the chromosomes of the parental species during the meiosis in F_1.

The differences among the trigenomal plants recorded above remind of those that are characteristic for the "mutant forms" in *Oenothera* "species" where not single characters, but a series of characters, are usually involved, in other words in these "mutations" obviously more than one gene are involved. Perhaps, it would not be right to call them "mutations", nor structural hybrids (as the *Oenothera* "species"). The term "cross-over-forms" may be more suitable for them.

It is quite possible that some of the differences observed in the trigenomal hybrids may be due to certain translocations, inversions, or to some other phenomena of these kinds, but we must add that such phenomena usually occur very rarely. Therefore the most probable cause for the differences in the trigenomal species hybrids is undoubtedly due to the occurrence of crossing over between the chromosomes (specially the chromatids of the maternal and paternal species).

There must be drawn a sharp line between the cross-over-forms and the gene mutations that may occur following hybridisation. The latter seem to appear (and can be expected) not so frequently as the former. Gene mutations can be distinguished with great difficulty from the segregations following hybridisation. We can be sure we have found a gene mutation following hybridisation when we see some recessive forms among the progeny of F_2- or subsequent generations of the hybrids of homozygous parents with dominant characters. The mutation rate among such progeny must be compared, of course, with the mutation rate of the parental forms. Such a case we have observed in *Capsicum*, where from crossing of two homozygous red peppers (red fruit) an F_2-generation has been produced with 1·37% plants having orange fruits when ripe. No mutations have been found among the progeny of parental forms. Another case that should be mentioned here is that in rye. Some of the F_1-hybrids produced from homozygous *Secale cereale*×*montanum* (concerning the presence of chlorophyll) gave in the F_2-generation various percentages of albinos. The albinos produced by Vavilov and Jakushkina in the F_1-generation after crossing *Triticum persicum* with other wheat species do not seem to belong to these categories. Their nature will be discussed elsewhere. But the occurrence of 1·74% white flowering plants in F_2 (*Aquilegia vulgaris*×*chrisantha*) (the former has violet flowers, the latter yellow) studied by Skalinska, seem to be due to gene mutations following hybridisation. The appearance of white flowering *Medicago* in the F_2-generation of the cross *M. sativa*×*falcata* (the former has violet flowers, the latter yellow) can be interpreted on the same basis.

The occurrence of recessive gene mutations in species crosses does not lead only to a degeneration of the organisms ("*reductio ad absurdum*" in Batesonian sense) when treated from an evolutionary point of view, because (1) the appearance of dominant gene mutations may occur parallel with the occurrence of the recessives, but we cannot separate the former so easily as the latter from the recombinations, and (2) it is quite possible that recessive gene mutations may serve as a source for the dominant genes when certain gene modifiers are involved in the way Fisher suggested in his theory of dominance.

From the data here presented we may conclude that crossing over occurs between the maternal and paternal chromosomes in the species hybrids, a process that conditions the manifoldness of the trigenomal species hybrids. This manifoldness is due to the structural changes in the chromatin but not to the changes in the genes and they must be separated from the gene mutations that occur following hybridisation. Both are of a great importance for the origin of the species as well as for phylogeny in general.

The multiple associations of the chromosomes in F_2—F_4 in the fully fertile triple

trigenomal hybrid *N. tabacum* × (*sylvestris* × *Rusbyi*) = *N. triplex* observed before (1933) can also be interpreted by postulating structural exchanges in the chromosomes, a process which contributes a great deal to the increase of the genotypical variability of the composite plant *N. triplex*.

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Periodic Continence *Vs.* Contraceptives.

By D. Ferroli, S.J., D.Sc.,

St. Aloysius' College, Mangalore.

I. THE KNAUS-OGINO DISCOVERY.

WITH regard to the fertility of women, people have always thought that it is greatest within the period which immediately precedes and follows menstruation. For the last fifty years Dr. Capellmann's theory was often followed. In order to avoid undesirable pregnancy, he counselled abstention the first fourteen, and the last five days, of the menstrual cycle. A reaction set in among standing gynecologists towards the beginning of the century; and, after the researches of Siegel, Jäger and others, it was generally admitted that, though there exist cycle periods of maximum and minimum fecundity, properly speaking, there is no agenesic period.

In 1929 Dr. Knaus showed that, for a normal menstrual cycle of twenty-eight days, ovulation occurs between the fourteenth and the sixteenth day *from the beginning* of the menstrual flow. Dr. Knaus's researches, which were confirmed by Wittenbeck and Hermstein, did not apply to irregular cycles.

It was the Japanese Dr. Ogino, who, in 1930, solved the problem completely. He showed that, whatever the length of the menstrual cycle, the date of ovulation is separated *from the next* menstruation by a *definite* period. In other words, *the peak of ovulation always takes place between the sixteenth and the twelfth day before the next menstruation*. It is during these five days that fecundity occurs.

But may not ovulation be provoked by coition? Though the positive solution was accepted till recently by many gynecologists it is now almost universally rejected. Thus the human species follows the behaviour normal among mammals. The statistics, which have been held to demonstrate the contrary, were shown to be unreliable by Ogino.

Another objection was based on the supposed lengthy vitality of the ovum and of human spermatozoa. The researches conducted by Hoene and Behne with regard to the spermatozoa, and by Meyer Allen and Pratt with regard to the ovum, answered the objection, and led to *Ogino's rule. The eleven days immediately preceding menstruation are always sterile.* The law of inertia explains the slowness of medical opinion in accepting these conclusions.

II. PRACTICAL APPLICATIONS.

In Ogino's rule we have a method for obtaining *rational fecundity*, which consists in regulating the birth of children without injury to the mother, without risking the health of the offspring, without imperilling the harmony of the family, and without running counter the enlightened dictates of sound eugenics.

Yet it has been contended that the rule is unsafe for nearly fifty per cent. of women. This exaggerated view springs from a confusion of normal with pathological cases. Gynecologists tended to regard as normal a twenty-eight-days cycle. Now this estimation is too narrow. Twenty-eight-days cycles, admitting oscillations of a maximum amplitude of five days, may be regarded as normal, and to them Ogino's rule may be applied.

The maximum fecundity occurs within five days. Three more days have to be allowed for the possible vitality of the spermatozoa. Hence, to avoid pregnancy, abstention, for a twenty-eight-days cycle,

must extend to eight days. On the other hand, a cycle 26-27 demands nine days of abstention. A cycle 26-28, or 28-30 demands ten days, and so on. Formulæ and tables have been published to facilitate the determination of the fertile days, in which intercourse is to be shunned, if conception is to be avoided.

The cycles for which the periodicity of oscillations cannot be assigned must be regarded as pathological. To them Ogino's rule cannot be applied. Hajek found oscillations exceeding 11 days in 192 women out of 1,215. Smulders and De Guchteneere declare that only rarely the irregularity is so great that the method is unsafe. They note, however, that very bad cases can often be improved by proper treatment. The security afforded by periodical continence depends on the exact application of the agenesic formula. It is plain that a competent gynecologist should be consulted, and he will require several months of observation before fixing the final formula. Allowance must always be made for critical epochs, such as marriage, childbirth, miscarriage, which pregnantly modify the menstrual rhythm. In fact, abstinence should be counselled till a regular rhythm is re-established. It should not be forgotten that in "asthenic" women keen emotions, troubles, a change of climate, may temporarily suspend or delay ovulation. Dr. De Guchteneere then recommends only the premenstrual agenesic period, reduced from eleven to nine or even eight days.

Remembering that, though all vital functions follow a definite rhythm, yet man is more than a mechanism, and consequently rigid formulæ are to be mistrusted; remembering also that many mishaps are to be traced to individual carelessness rather than to the deficiencies of Ogino's rule, we may say that periodical continence based on the same rule, affords—not indeed the absolute security of total abstinence—but the relative security of any artificial method.

Future advance in physiology will surely succeed in determining the exact date of the peak of ovulation, and the consequent length of the agenesic periods. Meanwhile, the prudent application of the Knaus-Ogino method will afford relief in the majority of cases, whereas absolute continency is not advisable, and the mother's health, the economic status of the family or other reasonable motives to militate against a new pregnancy. We believe that the conditions of society in industrial centres, among government officials, teachers, clerks, make both unchecked fecundity and absolute continence equally difficult. As long as present conditions last, periodical abstinence offers a fair solution of a most acute problem, which only too often has opened the door to solitary vice, the use of contraceptives or even downright adultery.

III. MORAL CONSIDERATIONS.

It has been contended that the sexual function is on the same level as digestion and consequently is outside the sphere of morality. No doubt, the elaboration of the semen in man, and the menstrual cycle in women, are purely physiological processes, which do not fall under the sway of free will. But, as eating and drinking, at a certain period of development, evolve from purely instinctive operations to actions that are distinctly human; and man, though incapable of suppressing hunger and thirst, can, and has to, regulate their satisfaction, so the sexual function, though based on a physiological mechanism, transcends the same, and in man, rises to the moral order, and in certain of its activities falls under the usual law.

Now we may distinguish the positive moral law and the natural moral law. The natural usual law, regarded in God, is eternal; and it is God's supreme wisdom and will, which commands the keeping of the natural order, and forbids its violation. The natural moral law, regarded in man, is a sharing of the eternal law, through the light of reason, by which we discover what we should, and what we should not do. It is called "natural" because it is based on man's reason, and not on revelation. It is this natural moral law that bids us to speak the truth, to love and obey our parents, not to do harm to our neighbour. We call it natural, because it is not based on a mere precept, but on man's rational nature. To act deliberately against it is to sin against reason, *i.e.*, against the nature of man. It is therefore an offence against the dignity of man, and against God, who is our Creator, and the Maker of our nature.

Endeavouring now to apply these principles to the sexual function, we notice first of all that its obvious scope is the preservation of the race. We may gauge its nobility from the fact that, by its proper exercise, man shares in a way the creative power of God. The pleasure, which is inherent in it, is of the same kind as the pleasure of

eating and drinking. It is perfectly natural, and, when it accompanies the proper exercise of the function, is good, even as the function is good. But just as a gourmand offends against the natural order by severing the pleasure of eating from the nourishment and sustenance of the body, and lives to eat, but does not eat to live, so an unchaste man severs the sexual pleasure from the natural effect of the sexual act. He thereby upsets the order of nature, seeking pleasure as an end, though in connexion with sexual activity, it is a means.

Thus appears the philosophic reason why solitary vice, homosexuality and prostitution are offences against the natural law.

Now, the use of contraceptives (chemical or mechanical) tends of itself to upset the sexual cycle, whose natural end is pregnancy. It deliberately sunders the pleasure of a natural act from the natural consequence of the same. It is therefore unreasonable; it is unnatural. I for one cannot see how in birth control through the use of contraceptives, the act differs morally from solitary vice or even homosexuality. In fact, I believe, it is usually more serious than mere solitary vice, for the continuous and fruitless stimulation of the female genital organs leads to serious disorders, both psychic and physiological.

IV. An Objection.

I have not great hopes that people endowed with the Neo-Malthusian mentality will readily see the strength of the philosophic argument I have just outlined. Others who admit man's dependence from a Supreme Cause and Ruler, not only in regard to the physical order, but also with respect to the moral order, will perceive the sinfulness of artificially tampering with the generative process. But they will ask themselves how the practical application of the Knaus-Ogino rule is consistent with the demands of morality.

It is to be noted at the outset that a person's intentions are not in question. A married couple may have intercourse in the normal manner, with a lustful mind. The action, which is good in its materiality, is vitiated by intention. But can a good intention "spiritualise" an intrinsically crooked action? We do not think so, for we believe that "the end does not justify the means".

Now to the matter in hand: the natural moral law demands that the sexual act should be performed normally and completely. It demands also that the health of the mother should be safeguarded, that children should not be brought into the world in utter disregard of the dictates of prudence. Circumstances may arise when a new birth may prove disastrous. Then abstinence is the obvious course. But prolonged abstinence may upset conjugal harmony, may, in individual cases, be unadvisable.

The Neo-Malthusians advise the use of contraceptives. We do not agree with them, for the reasons already given, and for other reasons, which we cannot develop here.

Then we counsel periodical continence, in the sense of the Knaus-Ogino rule.

Here the physiological processes are not interfered with. The natural effect of the act is not frustrated by artificial contrivances. Woman is not unjustly deprived of the benefits both physical and psychic, of certain substances, which are absorbed by the female organs, and act as metabolic stimulants. A new pregnancy is avoided simply by taking advantage of the normal cycles of sterility and fecundity. In other words, the Creator's law is made use of, which consists, in the spontaneous alteration of fertile and sterile days. This law is not of man's invention. It is natural. It is not twisted to immoral purposes, but is applied for good reasons. If women were unfit for sexual intercourse during the agenesic days, if they felt normal repugnance to it, we might pause and ask ourselves whether such an attitude were not indicative of moral perversion in the performance of the conjugal act during the sterile period. But no such unfitness, no normal repugnance is discoverable.

Hence we believe that no moral blemish can be attached to those who regulate their conjugal life according to the Knaus-Ogino rule.

It is finally to be noted that while continence is the basis of the Knaus-Ogino system, contraception implies the total denial of continence.

We believe that total continence may be exercised by a few (both in marriage and outside marriage), whose normal training is of a very high order, and whose spiritual ideals are divinised by constant communion with God. For the majority, the normal exercise of the sexual function in marriage is not fraught with any danger or with any serious consequences. They should be generous, and should not shirk the burdens, and blessings of numerous families. To those

unfortunates—and they are luckily few—for whom eugenic reasons, or economic reasons of a serious character, dissuade normal generation, we counsel periodic continence—and we believe the counsel is good and praiseworthy.

Fruit Research in India: Its Importance, History and Scope.

By Dr. G. S. Cheema, D.Sc., I.A.S.,
Horticulturist to Government, Bombay, Poona.

INTRODUCTORY.

JUST as the Department of Agriculture forms a minor subject in the administrative classification of the Government of India, the development of fruit industry forms indeed a very small part of the activities of the Agricultural Departments in India, in spite of the fact that India claims to have more than five million acres under fruit and vegetables. Consequently this country, which has great potentialities for development, imports annually fruit worth about twenty million rupees from foreign countries. Not only is this so, but while the acreage under fruit and vegetables has remained practically stationary for several years past, the imports of foreign fruit have increased by leaps and bounds in recent years. The steady acreage under fruit and vegetable and the increasing imports indicate that the total consumption in the country of these commodities has increased but it has not been followed by any extension of fruit and vegetable cultivation.

The importance of the development of the fruit industry is, however, recently attracting the attention of the Agricultural mind in various parts of India, which is indeed a welcome sign of awakening in the right direction. The Imperial Department of Agriculture is now financing some fruit schemes in the different provinces with a view to develop this industry. It is generally recognised that in the economic uplift of rural areas, in the financial success of large irrigation projects which are undertaken at the cost of huge amounts in the Deccan, Sind and other parts of the country, and in the successful development of vast tracts of countryside, where the ordinary agricultural crops are not a financial success, the fruit industry will play a very important rôle. It is then natural that the question of fruit research should play as much part in the agricultural development of the country as any other branch of agricultural science, this being an important and valuable source of income to the peasant. The present time is, therefore, most opportune to stress upon the minds of the general public the great importance of fruit research in India, and this note will have fully served its purpose if it does so.

HISTORY OF FRUIT RESEARCH.

The fruit research dates back to the middle of the nineteenth century. Ferminger (1863), Woodrow (1877) and Bonavia (1890) have made valuable contributions to the limited volume of literature on the subject in India, by their attempts to describe the existing varieties of fruit and to classify them as far as possible.

The records of the work done under the auspices of the Pusa Institute of Agriculture show but very little headway made in this direction. This work chiefly deals with the establishment of a Fruit Farm at Quetta, and some work on the drying and packing of vegetables.

The United Provinces Department of Agriculture have restricted its activities to the establishment of farms and variety trials of exotic fruits. The Saharanpur Botanical Gardens have contributed substantially towards this work from the early years of the nineteenth century.

The Tarnab fruit farm has shown active interest in the development of the fruit industry in the North-Western Frontier Provinces. The introduction of improved varieties of plums in this Province is perhaps one of the few important projects which this Farm has carried out successfully. Some observations on the improvement of fruit stock have also been recorded in the reports of this Farm.

The Punjab and Central Provinces Departments of Agriculture have also done some work in this line. In the Punjab, a regular Department of Horticulture has been recently organised, and fruit work is making progress.

The Bombay Department of Agriculture organised their horticultural work as late as 1908, when the investigations on fruit trees were allied with botanical research. The

records show that a fair attempt was made to study the needs of the industry in the various parts of the Presidency, and to indicate possible lines of research to be adopted to solve the problems of the fruit grower.

It was in 1921, that the Bombay Department of Agriculture took the lead and organised a special horticultural branch with a view to solve the various problems of fruit growing in the Presidency. A great effort is made to bring the work of the Bombay Department of Horticulture in line with the recommendations of the Royal Commission on Agriculture in India. Their activities to evolve improved strains of fruit by selection, the study of the soils and their relations to the growth of fruit trees, and the marketing investigations are now well in hand. This department has also attempted successfully for the first time in the history of Indian fruits the problem of Export of Indian Fruit to the European markets.

The Madras Presidency, Bihar and Orissa and Bengal are yet studying the means to establish their fruit farms and to stimulate researches in this direction in the near future.

It is observed from the survey of work done that the earlier attempts at horticultural research were spasmodic and lacked continuity—a factor which is essential to build up a really scientific structure. It may be true that these attempts have but poorly subscribed to the industrial benefit of the country, but the importance of the work cannot be belittled, as a beginning had to be made perhaps in this very manner.

It may be clearly stated here that although the fruit industry and researches towards its development, now form the major part of the activities of most of the agriculturally advanced countries of the world like Italy, France, and various states of the United States of America, almost every country started her work under equally undeveloped conditions. It is only with steady and thorough research and organisation that they have built up their modern industry. Italy could not have held the monopoly of fruit products if she had not staked millions of liras in finding ways and means to improve the quality of their fruit crops and developed a system of handling and marketing them efficiently. The United States of America could not have developed their fruit industry to the present high level, if they had not spent millions of dollars in fruit researches, nor could the French have boasted of their high efficiency if their Government were holding back the expenditure of their gold. The same principles hold good to the conditions of the present-day India. It is feared that no developments in this direction are possible, without properly organising and following up researches on fruit.

It is surprising to note that in India the majority of the Provinces have not as yet established even a fruit farm where such researches can be carried out. But it is recently announced that the Imperial Council of Agricultural Research has taken the initiative in this direction and has agreed to finance some of the Provinces in establishing their fruit farms.

The importance of fruit researches till recently was not fully recognised by any Department of Agriculture in India, and probably it is this fact which largely accounts for the neglect of these researches.

SCOPE FOR WORK.

Even at present as explained above, almost every branch of the Indian fruit industry remains still to be explored fully and the Science presents a wide field for active research. The chief lines of work for the development may be classified under the following heads:—

1. Improvement in the quality of seeds and nursery stock and their standardisation.
2. Improvements in the methods of cultivation and the control of diseases.
3. Efficiency in transport and safety in delivery of fresh fruit.
4. Improvement in the system of marketing and storing fruit.
5. Proper utilisation of the surplus produce.

The Royal Commission on Agriculture in India have devoted a chapter in their report to horticulture and plantations, and have indicated the possible lines of research to be conducted for the development of the fruit industry. The Commission report: "There is, however, much important research work to be done, notably in selecting and classifying root stocks. The aggregate number of fruit trees in the country is very large and an improvement in quality alone, quite apart from the increase in number, would confer great benefits on the people." The Commission further proceed to state that investigations into transport and markets

must form an essential part of any policy of active encouragement of either fruit or vegetable production. They also suggest that the possibilities of the home market for preserved and dried fruit and vegetables should be explored.

In fact researches in all these directions must be conducted simultaneously, or else the immediate benefit of any investigation in any particular line cannot be felt. For example, it is now found possible to export mangoes to European countries, but it is not possible to make this a commercially practicable project until and unless suitable and more economical transport facilities are secured for this trade. Comprehensive researches in all allied lines are, therefore, essential to succeed in the development of an industry.

(1) Now turning to the lines of research indicated above individually, it is felt that a great deal of investigation is required in selecting and standardising our fruit and vegetable before a desirable quality for the market is obtained. It is really not known if any definite effort is already being made in this line in India, as yet. References, however, are available giving expression to the necessity of these investigations and reporting about certain abortive attempts made here and there. The disjointed nature of these accounts seems to be due to lack of funds and policy and perhaps necessary amount of patience so essential in following up research. Investigations to improve the quality of seeds and nursery stock are imperative as they form the basis of the whole structure on which the industry can be built.

(2) Improvements in the methods of cultivation of our fruit trees, and the control of diseases and pests form another important aspect of this industry. A very fruitful research work can be undertaken to find out the suitability and adaptation of various varieties of fruit to soil and climatic conditions of different tracts. The physiological effects of various soils on the growth of commercial strains also require a careful and detailed investigation. The present tendency is to refer to foreign literature and to advise prospective growers to follow foreign treatments. Such advice is often found to be far from satisfactory, and in many cases it is found disappointing and ruinous. There are instances where hurried observations seem to establish facts which do not stand later tests. There are also instances where application of foreign treatments has completely destroyed plantations. There are also cases where money spent on treatment is not economical and the benefits which accrued discourage to follow such remedies. Most unfortunately, however, a disregard of these points even on the part of high authorities has already proved a ruinous policy. Research in this line is expected to be as profitable as in any other line and presents a very great scope for work.

(3) The conditions with regard to cost and efficiency of transport and the safety of goods during transit are at present extremely unsatisfactory in India. This line of development embraces a wide field. The proper packing materials to suit the requirement of the present means of transport is yet to be designed. Researches are needed in the ways and means of stocking and hauling packages and economically transporting them from the place of cultivation to the distributing centre. Researches in this direction appear to be of an inter-provincial nature and one can easily find reason why they are neglected. There is no inter-provincial activity at present so far as this aspect of fruit trade is concerned. All provinces are carrying on their work in a very air-tight compartment manner. But no one can deny that this line of research forms a very integral part of the development of the industry as a whole. It is no use having a good quality of fruit if it cannot be exported or transported to places of demand. It is no use opening up large plantations and spending money if the produce cannot be economically distributed.

(4) The part which the system of marketing plays cannot be sufficiently emphasised. A small amount of research work in this direction has been done in India, but the findings could not be put into effect as several other allied agencies and factors such as transport, packing materials and freights, are not suitably harmonised. The Bombay Presidency, undoubtedly has taken the lead in this direction. The Government of Bombay have appointed a committee to investigate this subject. It is anticipated that the line of development which this Committee will suggest will be worth following. These researches will be useful for inter-provincial work. But there is a need for undertaking such researches in other Provinces to solve their local difficulties.

(5) The utilisation of surplus produce of the season is another line where researches lack in India. Recently a couple of schemes such as the Manufacture of Lime Juice in the Bombay Deccan and the Establishing of a Canning Laboratory in the North-West Frontier Provinces have appeared before the public. Beside these schemes, there does not seem to be anything else of much interest. The failure of Koonoor Laboratory of course has caused some setback in this direction. Of course, the best way to get over such a difficulty is to have well-considered projects before money is invested and effort is made to carry on the work. The failure of one scheme should not necessarily discourage the carrying out of another. There is no denying of the fact that failures in researches will be as common as successes if not more.

The above outline will show that practically every aspect of fruit industry remains to be studied. Considerable preliminary experimental work must be conducted probably at considerable expenditure to organise researches in this direction. It will not be out of place to mention at this stage the chief ways by which fruit researches can be successfully carried out. It is suggested that the fruit researches must be classified as the *Central Subjects* and the *Provincial Subjects*.

The following research work may be included in the list of *Central Subjects*:—

(*a*) Researches relating to the import and export of fresh fruits and fruit products.
(*b*) The problems connected with the marketing of fruit including transport.
(*c*) The investigations relating to the preservation of fruit and the manufacture of their products.

Other researches are more of a provincial nature and may be left to the Provincial Departments to follow. These can be grouped as follows:—

1. Investigation connected with the formation, structural fertility and management of soils suitable for fruit culture.

2. The study of various climatic conditions, their suitability to the growth of various crops and the selection of suitable commercial varieties.

3. The work of propagation.

4. Problems connected with the lay-out and general cultural operations.

5. The extension of area under different crops.

Such a division of work in dealing with fruit researches is indispensable. As may be seen from the items put under the central subjects they involve an all-India and inter-provincial activity. The Central Government is the only competent authority that can handle questions and problems of such wide dimensions. The present administrative restrictions do not allow the Provincial Governments to pay any attention to these subjects. Even if they tried, they would find it not only an expensive affair owing to lack of facilities but also an irksome matter causing delay at every step. Then the Provincial Governments have not the necessary freedom of action in these matters. Necessary rules and regulations of Government in developing an All-India Industry can be framed and issued by the Central Government alone to make them effective.

The fruit industry and research in it are in fact in their infancy. Its importance is always overshadowed by other agricultural developments, thus throwing in the background these researches. It is anticipated that with the present awakening in Agricultural Department these researches will be given equal place as those relating to other agricultural industries. The effort which is required to be made to develop this industry and put it on a sound footing is not in any way less expensive and less cumbersome than other developments and these activities should not be considered of less importance as it is commonly understood.

Letters to the Editor.

The Colouring Matter of the Seed-Coat of *Abrus precatorius*, Linn. (Scarlet Variety).

THE first attempt towards the isolation of the colouring matter of *Abrus* seeds was made by Sarkar (*Biochem. J.*, **8**, 281-86, 1914) who extracted two colouring matters, yellow and scarlet, by soaking the crushed seed-coat in water and finally separating them with ether. He purified the scarlet colouring matter by preparing the insoluble copper salt and from a study of some colour reactions concluded it to be a tannin substance. The next reference that "anthocyanin is sometimes developed in the cells of the testa of seeds of *Abrus*" is recorded in Onslow's book (*The Anthocyanin Pigments of Plants*, 1925, p. 30).

The present author has, however, been able to isolate an anthocyanin and gallic acid from the seed-coat. The presence of gallic acid probably confused Sarkar to come to the premature conclusion that the colouring matter of *Abrus precatorius* was a tannin substance. The anthocyanin has been named *abranin*.

Hot aqueous extract of the crushed seed-coat is precipitated with excess of lead acetate. The lead salt is macerated with glacial acetic acid in the cold and the filtrate which is of a pink red colour is precipitated with ether till the pink colour of the solution just disappears. The colouring matter is obtained by decomposing the precipitated blue lead salt in ethyl alcohol (98%) suspension with hydrochloric acid and finally precipitating the filtrate with ether. The crude abranin chloride thus obtained on purification in the usual way and on remaining over calcium chloride in a vacuum desiccator melts at 178–79° with previous sintering. Gallic acid is obtained by decomposing the lead salt that is recovered on concentrating the acetic acid filtrate.

Abranin chloride isomerises readily in neutral solvents like water, methyl and ethyl alcohols, etc. Its colour reactions have been studied. The sugar of hydrolysis of abranin chloride has been identified to be glucose. Abranin picrate, prepared in the usual way, has been obtained in the form of chocolate-red plates and melts at 149–50°. Determination of the distribution number of the substance confirms it to be a monoglucoside. The absorption spectra of the colouring matter in methyl alcohol-hydrochloric acid have been studied.

NARENDRANATH GHATAK.

Chemical Laboratory,
Allahabad University,
December 10, 1933.

Bacteria in relation to Soil Fertility and Crop Yield.

"A PROBABLE correlation between soil fertility, crop yield and the number of Microflora has been suggested by various workers. The writer while working at Rothamsted on Hoos-field (Permanent Barley) plots was able to show that a correlation existed between soil fertility, crop growth and the number of Bacteria in the soil. Since his return to India he has been engaged in making Microbiological investigations in connection with the reclamation of Alkali soils. The reclamation work is being carried on barren lands in the Punjab and these cover a good deal of area in the Province. Soils were brought from the experimental fields with a soil borer from surface soil 0"–6". About half a dozen plantings were done. The medium used was Thornton's Mannite Agar. The following dilutions were made:—

1. 25 grams of soil in 250 c.c. of water 1/25.
2. 1 c.c. of (1) in 100 c.c. of water 1/250.
3. 1 c.c. of (2) in 100 c.c. of water 1/250000.

Total number of colonies were counted after a week's incubation and the average taken from the five plates examined for each plot. The yield of rice crop is taken as an indication of the state of reclamation and the stages of reclamation which are recognised at the Chakkianwali Reclamation Farm (Punjab) are as follows:—

(*a*) If the yield of rice crop is 12 maunds or below, the land is only partially reclaimed.

(*b*) If the yield of rice crop is between 12 to 20 maunds per acre this indicates an advance of reclamation over (*a*).

(*c*) If the rice crop is 20 maunds per acre or over then the land is considered to be fully reclaimed.

With a view of obtaining comparison which would indicate the stage of reclamation reached the writer has been engaged in carrying on work on the quantitative aspects of Bacterial numbers in the different types

of soils produced during the process of reclamation.

These replicated studies have shown that quantitatively the number of Bacteria is different in various plots reclaimed and it is of great interest to note that there seems to be a definite correlation between soil fertility as indicated by the crop growth and the number of Bacteria. Thus different plots of reclaimed soils, namely, those which give a yield of (i) over 20 maunds, (ii) between 12 to 20 maunds, (iii) below 12 maunds show Bacterial numbers of the magnitude of 19,750,000; 14,250,000; 8,250,000; and 5,250,000 per gram of dry soil respectively.

A similar correlation has recently been established by Dr. A. N. Puri [*Punjab Irrigation Research Laboratory Memoirs (in press)*] between the degree of alkalisation or saline contents and the crop yield, the greater the saline contents, the lesser the yield and *vice versa*.

These observations seem to indicate that during the process of reclamation of Alkali soils different plots giving different Rice yields have Bacterial population also different, the number of Bacteria having a correlation with the crop yield."

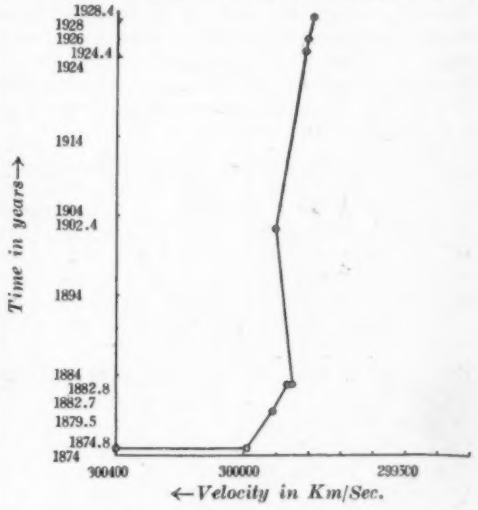
JAGJIWAN SINGH AHLUWALIA.

Botanical Laboratories,
Government College,
Lahore,
December 15, 1933.

The Velocity of Light.

DR. ALARABY in a brief note on the decrement of the velocity of light[1] mentioning De Bray's article[2] gives us to understand that the details would be published in the *Ind. J. Phys.* and the *Phys. Rev.* Hence it would be premature on our part to question his conclusions, yet we have no hesitation to contend that so far we are not in possession of even a *single* definite experimental evidence to point out the decrement in the actual velocity of light. So any mathematical account calculated on the basis of the results up till now obtained certainly would prove erroneous. All the experimental results of the velocity of light so far quoted and derived only go to show that each experiment has led to obtain higher accuracy in the result and we are yet to determine the value of the 'constant'. Michelson himself after declaring his result[3] obtained in 1924 mentioned that in the succeeding year he would be able to 'furnish results four or five times more accurate'.

In *Nature* of Oct. 22, 1927, p. 602, De Bray has provided a table of experimental values of the velocty of light, indicating seven trustworthy determinations. Plotting the results we obtain the following graph which



is something of a sort of a sine curve and not merely a straight line inclined to the axis of time as mentioned in *Nature* of April 4, 1931, p. 522. De Bray secures a straight line in the graph as he only considers the results obtained after the year 1902. We maintain that if the curve fails to tend asymptotically it is because we have not as yet reached the value of the 'constant'.

Admitting for a moment the determinations as indicating the decrement how is it that the velocity of light *invariably* decreases in an 'excellent linear law of variation' in spite of the earth's magnetic field of varying intensity.

Even the General Theory of Relativity is not definite on this issue.

M. KARIM.
C. M. BHASKER RAO.

Aligarh,
February 6, 1934.

[1] *Curr. Sci.*, **2**, 244, 1934.
[2] *Nature*, April 4, 1931.
[3] *Nature*, Dec. 6, 1924, p. 831.

I HAVE read with interest the remark made by Messrs. Karim and Rao about my note concerning the velocity of light (*Curr. Sci.*, **2**, 244, 1934).

Of course due to many reasons no definite experiment has been carried out to study the variation in the velocity of light. Assuming such a variation without any reason and formulating a mathematical structure on this basis would be undoubtedly completely wrong. At this place we can ask the question: can we try to understand the results obtained by different observers from time to time in light of the Theory of Relativity (Vrkljan, *Zeit. f. Physik*, **63**, p. 688, 1930 and others) that seems to predict a variation in the velocity of light?

It is evident that the results obtained by different observers as quoted by De Bray are not accurate. A graph has been drawn by Messrs. Karim and Rao that they state to be like a sine curve—which is not a sine curve—the existence of such a curve will mean a periodic variation in the velocity of light. About the other letter of De Bray (*Nature*, April 4, 1931) they mention about the straight line and explain that "if the curve fails to tend asymptotically it is because we have not yet reached the value of the constant." I do not see how the asymptote comes in a way and what it has to do with it. Next they have pointed out about the magnetic field variation of earth mentioned by De Bray. As no definite relation expressable in equations has yet been found out, as to what will be the nature of variation it is difficult to say with certainty as to how the light should vary.

Here are we not justified to study the problem from the point of view of an expanding universe in which we may predict such an occurrence?

It seems so revolting at this stage to make a statement about the velocity of light, which would no doubt take at least hundreds of years of carefully observed data with more elaborate electrically measuring devices for finding out the velocity of light.

It would be interesting to note that it has been pointed out in *Nature* (Feb. 3, 1934, p. 169) that periodic variation in the velocity of light as observed at Mt. Wilson (*Nature*, **130**, 15, July 2; 277, Aug. 20, 1932) has been construed by the authorities of Mt. Wilson in Science Service to be due to some seasonal instrumental error. The best value of the velocity 299,774 Km./sec. is likely not going to change by more than one or two.....in the last figure. Pease and Pearson are carrying out further investigation with better methods, and we shall have to wait for years till definite results are obtained to prove that our theoretical calculations and *expectations* are wrong.

M. ALARABY.

Lyceum,
Arrah, B. and O.,
March 12, 1934.

On the Occurrence of Sori on the Upper Surface of the Leaf of *Nephrolepis davallioides* var. *furcans*.

OCCURRENCE of sori on the upper surface of the leaf of leptosporangiate ferns is rather uncommon. As far as I know this is reported in: *Aspidium* (*P*) *anomalum* (*Polystichum aculeatum*) (Hooker[1]), *Deparia moorei* (Thompson[2]), *Polypodium lepidotum*, *P. proliferum*, *Asplenium trichomanes*, *Scolopendium vulgare* (Moore[3]) and in the doubtful case of *Acrostichum* (*Rhepidopheris*) *peltatum* (Goebel[4]). In the present case the sori are superficial, borne on the upper surface and are always terminal on the open veins which do not reach the leaf margin (Figs. 1, 2, 3). They are all imperfectly developed, the indusium is scaly, peltate and white in colour and, as a result, the sori appear as white intramarginal patches along the margin of the pinnules. The sporophylls are normal leaves all the pinnules bearing the otherwise normal sori in regular order; and the phenomenon cannot be regarded in this case as anomalous, abnormal or accidental. I have examined over a hundred pot plants, and only 4 or 5 of them bore normal sori on the under-surface of the pinnules, and that too, only in 2 or 3 leaves in each plant. It seems that the plant is giving up propagation through asexual pores. The plants, in two pots, that have shown this phenomenon are still growing in my garden.

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[1] Hooker, *Species Filicum*, **4**, p. 27; also *Ferns*, **1**, p. 217.

[2] Thompson—*Trans. Roy. Soc.*, Edin. **50**, pp. 837-856.

[3] Moore, "Note on some Suprasoriferous Ferns", *Journ. Linn. Soc.*, **2**, pp. 129-30.

[4] Goebel, *Organography*, Part II (Eng. Ed.), pp. 486, 493-94.

Prof. Bower[5], who holds the abaxially superficial position of the sorus as derived from the primitive distal or marginal position as a result of 'phyletic slide' (pp. 219-22; also *Ann. Bot.*, **28**, p. 326), regards the above cases as anomalous (*cf.* Goebel, p. 494). Thompson, however, does not agree with Bower. He considers that these

Fig. 1.

Part of the Sporophyll showing Sori on the upper surface. Size normal.

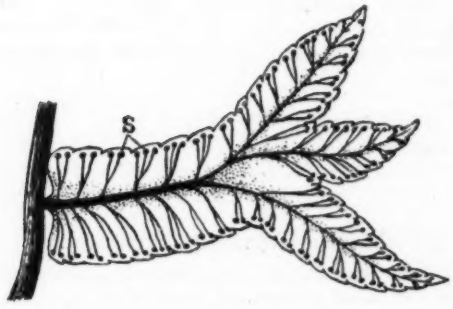


Fig. 2.

A Pinnule. ×2. S—Sori.

occurrences of adaxially superficial sori are in consequence of certain yet undetermined conditions (p. 855). But both of them seem to agree with Goebel that "the sporangia in general strive for a position on the under

[5] Bower, *The Ferns*, 1, Chap. XII; *cf.* also *Origin of a Land Flora*, Chap XI.

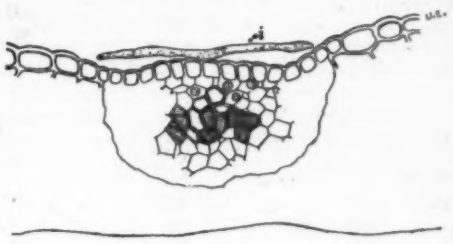


Fig. 3.

A Sorus in cross-section: Camra lucida drawing. Semi-diagrammatic. × 300. *i*—scaly indusium. UE.—upper epidermis.

side of the leaf the more the portion of the sporophyll bearing the sporangia is constructed like a foliage leaf" (p. 494).

From a study of the primitive groups of pteridophytes, living and fossil, where the adaxially superficial position of the sporangium appears to be the rule, the present writer is inclined to suggest that the almost normal occurrence of such cases in so many diverse groups of leptosporangiate ferns might refer to a stage abandoned in the phyletic march in the position of these organs from axis—axil—upper-surface—intramargin—margin—under-surface of the leaf for "the imperfectly developed parts have played important rôle in arguments on Evolution" (Bower, p. 162).

GIRIJA PRASANNA MAJUMDAR.

Department of Botany,
Presidency College,
Calcutta.

February 19, 1934.

Isomerism in Chloralides.

RECENTLY Chattaway and Bell (*J.* 1934, page 43) have studied the isomerism of the condensation products of chloral with some phenols.

We have also been working on the isomerism of chloralides derived from α-hydroxy acids, the preliminary note on which was read at the meeting of Chemistry Section of Indian Science Congress, Bombay, 1934.

In view of Chattaway and Bell's paper, we think it necessary to publish some of our results.

From the condensation products of different α-hydroxy carboxylic acids with chloral

hydrate (in presence of H_2SO_4), two chloralides have been obtained after careful recrystallisations. Thus, *d*-tartaric, racemic and lactic acids have each given two chloralides.

Chloralides of	Melting Points
d-tartaric acid	(i) 162° and (ii) 175°
Racemic acid	(i) 160° and (ii) 215°
Lactic acid (Merck's)	(i) 62° and (ii) B. P. 212°

Lactic acid chloralides are being carefully studied.

This line of investigation will greatly help to remove the discrepancies that are found with regard to the melting points of the chloralides already recorded in literature: some of them may be due to cis-trans-isomers.

N. M. SHAH.
R. L. ALIMCHANDANI.

Karnatak College,
Dharwar,
March 3, 1934.

The Structure of Singly Ionised Selenium.

IN continuation of the work of the writers on Se III* the analysis of the spectrum of singly ionised selenium has been completed. The source employed was the ordinary discharge tube, wherein pure powdered selenium was heated. The very extreme ultraviolet region, the vacuum spark between aluminium poles tipped with metallic selenium served as a convenient source in addition to the discharge through capillary tubes.

This spectrum was observed to be similar in many respects to the spectrum of As I.† The intervals 5s $^4P_1$—$^4P_2$, and 5s $^4P_2$—$^4P_3$ are found to be 1483·5 and 1920·9 respectively. Adopting a value of 5s $^4P_3$ = 76320 calculated from appropriate series members the absolute values of the various energy states characteristic of Se II could be obtained. Some of these are:

5s $^2P_2$=73638
5p $^4D_3$=58932
5p $^4P_3$=56602
5p $^4S_2$=55692

The intervals of 5p $^4D_4$ terms are 412·7, 1356·4 and 1730·6 while the 5p ^4P term intervals are 3728·1 and 1621·2. A full report of the results obtained will be published shortly in the *Proceedings of the Royal Society of London.*

S. GOPALAKRISHNA MURTY.
K. R. RAO.

Science College,
Andhra University,
March 8, 1934.

* *Curr. Sci.*, **1**, June 1932.
† A. S. Rao, *Proc. Phys. Soc.*, **44**, 594, 1932.

Spectrum of Ce III.

MR. DABHOLKAR, in a note published in the February issue of *Current Science*, has made some observations on my work on the regularities in the spectrum of doubly ionised cerium. The error pointed out by him regarding the classification of the line λ 2238·69 is only a case of misprint. If he would be kind enough to look into my paper again, he would notice that the combination A—*k* is to be replaced by $5d^2\ ^3F_2$—*k*. The fact that 44655·1 is given as one of the term values should have made the change clear. It may be pointed out here that the frequency differences in my analysis of Ce III lines were mostly found to be correct to within ·1 frequency units. The analysis explains practically all the strong lines and there can be no doubt about the genuineness of the terms which have been discovered. The fixing of J and K values of the terms in a spectrum like that of Ce III can, for obvious reasons, hardly be expected to indicate anything more than a personal opinion, and it is therefore needless to enter into a discussion of this aspect of the matter here.

P. N. KALIA.

Department of Physics,
Government College, Lahore,
March 15, 1934.

Oxidising Agents as Fertilisers.

IT has been shown in a previous communication[1] that improved growth of seedlings can be obtained by treating soils, manured or otherwise, with different oxidising agents. As the results were of much scientific interest and, at the same time, indicated possibilities of extended practical application, further work was carried out growing different plants in pots as well as plots, and studying the influence of various treatments on general growth and yield of crop.

[1] *Nature*, **132**, 1001, 1933.

It was observed that vigorous oxidising agents like potassium permanganate or hydrogen peroxide were effective when applied either before the organic manure or at the same time with it: they tended to depress the yield if applied as top dressings 2–3 weeks after sowing. On the other hand, milder agents like the oxides of iron or manganese produced the most favourable effects when applied, as top dressings, at least a fortnight after sowing or transplanting as the case may be. In all the cases, the improvements were noted to be all-round, shoot height, leaf area, tillering and grain formation being favoured by the treatment. The following are some of the results obtained :—

TABLE I.

POT EXPERIMENTS.

TREATMENT	YIELD IN GRAMS			
	Ragi (*Eleucine coracana*)		French beans (*Phraseolus vulgaris*)	
	Grain	Straw	Pods	Stem and root
POT EXPERIMENTS.				
Soil (30 lbs.) + Seed-cake (30·0 g.) + Super (3·0 g.) + Potassium nitrate (2·0 g.) + Potassium sulphate (1·5 g.) (*Control*) ..	296·4	115·7	67·4	22·0
Control + Fe_2O_3 (30·0 g.) applied as top dressing	343·7	124·5	102·8	26·8
Control + MnO_2 (7·5 g.)	345·2	116·4	104·0	28·2
Control + H_2O_2 (50 c.c. of 6 per cent.) ..	319·6	120·3	80·7	24·1
Control + $KMnO_4$ (3·0 g.) (applied before sowing)	398·4	146·9	72·7	23·5
IN SMALL PLOTS (484 sq. ft. in each case).				
Unmanured (*Control*)	1430·5	1550·9	..	..
Unmanured + oxidising agents $KMnO_4$ (at 100 lbs. per acre)	2066·9	1786·0	..	..
Fertilised with farmyard manure alone (3 tons per acre) (*Control*)	2181·3	2100·4	..	..
Fertilised with $KMnO_4$ (100 lbs. per acre) (applied together with the farmyard manure)	2870·0	2797·0	..	..
Fertilised with $KMnO_4$ (100 lbs. per acre) applied in stages after the farmyard manure	2306·9	2313·5	..	..

The above observations have been supported by a number of other results so that it may be concluded that whether any manure is applied or not, treatment of the soil with oxidising agents leads to beneficial results.

The practical significance of some of the foregoing observations would be realised when it is stated that in many countries, tropical as well as temperate, there are vast tracts of land which are rich in iron or manganese—particularly the former—and contain high percentages of the corresponding oxides so that one has only to grind up rocks containing them and apply them to land in the desired proportion Since it has been observed that even soils which are naturally rich in iron respond favourably to the treatments, it may be inferred that all soils would give increased yields as the result of applications of top dressings of iron or manganese oxides.

The quantities of available mineral oxides —particularly that of iron—are far in excess

of the requirements of metallurgical industries, so that there is no fear of shortage of raw material for the latter. There are also vast supplies of low grade minerals which are unsuitable for other purposes and which could, with advantage, be utilised as fertilisers. The results of the present enquiry should also prove of value to the synthetic fertiliser industry by leading to the production of a new type of fertiliser which, in addition to supplying the mineral or nitrogen requirements of the plant, also facilitate the oxidation changes in the soil.

The fertilising action of different oxidising agents raises a fundamental question as to how they react with the soil and what effect they have on soil microflora and microfauna. As already observed, there is increased oxidation of organic matter resulting in greater evolution of carbon dioxide from the soil. This oxidation cannot, however, be correlated with microbiological activity which is prominent only immediately after the application of organic manure. The beneficial effect is best observed, at any rate, in the case of metallic oxides, only under conditions when micro-organisms are not actively functioning so that the oxidation changes observed in presence of the former would appear to be largely due to purely non-biological reactions.

A further question of practical importance which arises in this connection is as to whether it is desirable to adopt any system of fertilising which would lead to the rapid depletion of organic matter from the soil, whether it is not more important to devise means to conserve Carbon and Nitrogen in the soil rather than hasten their destruction. The observations of the present authors as also those of other workers in the field have shown that most cultivated soils, particularly in the tropics, have very poor retentive power for organic matter and that they get rapidly depleted irrespective of the quantities of organic manures applied to them. Owing to the favourable climatic and other conditions, the decomposition goes on practically all round the year so that the added manure possesses very little residual value. In the light of the above, it would appear to be more profitable to hasten the decomposition of organic matter during the lifetime of the crop for which it is applied and thus obtain the benefit of the increased yield rather than lose the unused residue after harvest and during periods of fallow. The quickened decomposition would only help to hasten the normal cycle of Carbon and Nitrogen in nature so that the foregoing observations would suggest the possibilities of a new system of fertiliser practice which would take advantage of the processes occurring in nature rather than devise means to oppose them. Further work is already in progress to extend the above and related observations, but it is also hoped that other workers would verify our findings and thus help towards further elucidation of their practical significance.

V. SUBRAHMANYAN.
C. R. HARIHARA IYER.
R. RAJAGOPALAN.

Department of Biochemistry,
Indian Institute of Science,
Bangalore,
March 25, 1934.

The Valence Angle of Oxygen in Dimethyl Oxide and Ethylene Oxide.

THE modes of vibration of a symmetric, non-linear triatomic molecule of the type XY_2 have been worked out by Bjerrum, Dennison and others. The three fundamental frequencies in its vibration spectrum are shown by these authors to be functions of the valence angle of the atom X, and of the binding forces between X and Y, and between Y and Y. From a knowledge of the vibration spectrum of the molecule, we can, therefore, calculate the valence angle of X and the binding forces between the atoms.

The valence angle of oxygen in dimethyl oxide $\begin{matrix}CH_3\\CH_3\end{matrix}\!\!>\!O$ calculated in this manner from its fundamental Raman frequencies 1102, 416 and 921 cm.$^{-1}$, is found to be about 102°. This is very near the tetrahedral angle of 109·5° usually supposed in theoretical discussions to represent the valence angles. On the other hand, in the heterocyclic compound ethylene oxide $\begin{matrix}CH_2\\|\\CH_2\end{matrix}\!\!>\!O$ if we calculate the valence angle in the same manner, it comes out much smaller. The principal Raman frequencies of this compound, as measured by me, are 865, 810 and 1151 cm.$^{-1}$, and they give for the angle a value of only 61°. The smaller value in this compound is evidently due to the presence of a chemical bond between its two carbon atoms, which is absent in dimethyl oxide; the bond will naturally bring the

two carbon atoms close together, and thus diminish the valence angle.

The large discrepancy between the angles in the two compounds is supported by independent evidence. The permanent dipole movements of dimethyl oxide and ethylene oxide are $1{\cdot}29 \times 10^{-18}$ and $1{\cdot}88 \times 10^{-18}$ e.s.u., respectively, the latter value being thus much larger. Indeed the two moments bear a ratio $\frac{1{\cdot}29}{1{\cdot}88} = 0{\cdot}69$, which is practically the same as the value $\frac{\cos 51^\circ}{\cos 32^\circ} = 0{\cdot}74$, which we should expect from their relative valence angles.

In connection with the above calculation of the valence angles from the Raman frequencies, we should add that in both the compounds the binding forces between the atoms come out of the proper magnitude.

N. GOPALA PAI.

210, Bowbazar Street,
Calcutta,
March 25, 1934.

A Note on the Disintegration of α-Particle.

IN a recent paper announced in *Current Science*, 1933, and since published in *Phil. Mag.*, **14**, p. 1097, 1933, we have derived the wave-statistical formula connecting the disintegration constant and the velocity of emission of α-particle, *viz.*,

$$\lambda = \text{Const.}\ \frac{\sqrt{E}}{\gamma_0^2\, h \cot u_0} \cdot e^{-2k(2u_0 - \sin 2u_0)} \quad ..(1)$$

where E = the energy of the α-particle, γ_0 = the critical radius of emission, $k = \frac{4\pi z^* e^2}{h\sqrt{2E/m}}$ and $u_0 = \frac{a\gamma_0}{4k}$ in which $a = \frac{4\pi\sqrt{2mE}}{h}$. This formula has been shown to closely agree with the experiment. From our theory we also obtain an interesting formula for the critical radius of emission, *viz.*,

$$\gamma_0 = \frac{9}{64\pi} \cdot \frac{h\nu}{\alpha z^* e^2} = \frac{9}{64\pi} \cdot \frac{h^2}{4\pi m z^* e^2} \quad ..(2)$$

being independent of the velocity of emission as it should be. It is, however, inversely proportional to the effective atomic number z^*. This appears quite natural when it is remembered that the packing of the nucleus increases with z^* and so the emission is likely to take place even from a smaller γ_0. For radium emanation Equation (2) gives $\gamma_0 = 1{\cdot}2 \times 10^{-15}$ cm.

On the other hand, with decreasing z^*, γ_0 increases and so the density of matter within the nucleus decreases. Ultimately a limit is reached when the damping coefficient or, in the language of wave-statistics, the viscosity of the corresponding phase space becomes vanishingly small and there is no longer spontaneous disintegration. Let us take the case of hydrogen, for which Equation (2) gives $\gamma_0 \sim 10^{-13}$ cm. There being no spontaneous disintegration in this case, the critical γ_0 should correspond to the size of the hydrogen nucleus consisting of a single proton. It is significant that γ_0 thus obtained is exactly of the right order for a free proton.

We shall conclude with a few remarks on the parallel wave-mechanical theories given by Gamow, Sexl and others. It may be noted that they do not obtain any expression for the critical radius of emission corresponding to the wave-statistical Equation (2). However, their equation for the disintegration constant is more or less similar to our equation (1). The important difference arises on account of their dropping the unknown constant which should involve the unknown normalising factor and some other unknown constant. They define $\lambda = \frac{G}{\tau}$, where G is the transmissibility and $\tau = \frac{2\gamma_0}{v}$, v being the velocity. It, however, appears to us that within the hard core τ can only be proportional to $\frac{2\gamma_0}{v}$ and not equal to it. This explains the latter constant. That the normalising factor has been dropped is evident from Sexl's rigorous treatment of the problem in *Zeit. f. Phys.*, **56**, p. 62, 1929 and **81**, p. 163, 1933.

K. C. KAR.
A. GANGULI.

Physical Research Laboratory,
Presidency College,
Calcutta,
March 26, 1934.

The Effect of Magnetic Field on Streams of Charged Particles.

ABOUT three months ago I announced the results of some of my observations on the effect of magnetic field on charged particles in motion. A short press report of this work was published later on in several newspapers in different parts of India on or about the 22nd January 1934. The following is a summary of some of those results obtained by me :—

(1) I observed that streams of fine gas bubbles evolved during electrolysis, which rose vertically upwards, were deflected by a magnetic field in a direction at right angles to the field. The direction of this deflection was reversed by reversing the magnetic field, and the extent of the deflection was found to depend upon the strength of the field. The deviation was different in the case of different gases evolved during the electrolysis of several solutions. Thus, during the electrolysis of sulphuric acid the bubbles of hydrogen gas were deflected in one direction and those of oxygen in the opposite direction, thus indicating that they were oppositely charged.

(2) Streams of hydrogen gas bubbles evolved during the decomposition of acids by metals like zinc, which is a purely chemical reaction, were not appreciably deflected by the magnetic field; but when a pure zinc piece with a copper wire wound round it was immersed in sulphuric acid, there was an immediate evolution of hydrogen gas bubbles, which were certainly deflected by the magnetic field. Thus in the cases examined by me so far the gas bubbles evolved during purely chemical reactions were not charged, whereas those liberated during an electrochemical reaction were electrically charged. I am at present making a systematic study of the effect of the magnetic field on the gas bubbles evolved in reactions of different types, and I expect that the results will throw light on the nature of these reactions.

(3) Further, I have found that streams of charged colloidal particles moving under the influence of an electric field were also deflected by a magnetic field, the direction of deviation depending upon the charge of the particles.

The fact that charged particles like the electrons, α-particles, etc., are deflected has been well established by the classical researches of Sir J. J. Thomson and others, and the idea underlying the above-mentioned observations of mine is therefore not altogether new. Nevertheless, the interest in my observations perhaps lies in the extension of the idea to the case of the charged colloidal particles, gas bubbles, etc., and particularly in the application of the phenomena observed by me to a number of important problems in modern physical chemistry. A short account of some of these applications is given below.

One of the applications is in the determination of the mass of the individual charged particles in colloidal solutions, suspensions, etc., by measuring the deflection of these charged particles as observed in an ultramicroscope under the simultaneous action of electric and magnetic fields. From a knowledge of the extent of deflection, the intensity of the applied fields and the charge of the particle, which is determined separately, the mass can be easily calculated. I am at present busy developing this technique. An account of the results will be published in the near future.

Another application is to the separation of diplogen (heavy hydrogen) from ordinary hydrogen—a problem which is receiving much attention at present. The method which I have adopted is as follows:—In the electrolysis of water containing an acid or an alkali the electrode at which hydrogen was evolved was made of a fine platinum wire, fused into one end of a narrow glass tubing so as to expose only a very small portion of it to the solution, and conditions were so adjusted as to give gas bubbles of practically uniform size. When the electric current was passed, a fine stream of bubbles was found to ascend upwards, but when the magnetic field was also applied the stream spread out into different streams. I believe that I have thus been able to separate diplogen from ordinary hydrogen. I am at present repeating these experiments under the most suitable conditions so as to confirm these results. The importance of such a method is obvious since, apart from the theoretical interest, it furnishes us with an easy method of obtaining diplogen in a pure state and in a short time.

A detailed account of these experiments will be shortly published. I have already communicated a note on these observations to Professor F. G. Donnan, C.B.E., F.R.S., (London) and to Professor The Svedberg (Upsala) two months ago. Owing to several interruptions in my work I have not been able to complete it earlier.

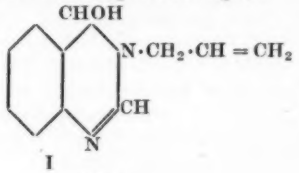
K. KRISHNAMURTI.

Chemical Laboratories,
College of Science,
Nagpur, C.P..
March 28, 1934.

Vasicin and Peganin.

IN a recent paper (*Ber.*, **67**, 45, 1934) Späth and Nikawitz have advanced the constitution I for an alkaloid, peganin,

isolated from *Peganum Harmola* which bears a striking resemblance to vasicin II. Späth and Nikawitz have drawn attention to the possibility of peganin being identical with vasicin but since peganin could not be isomerised by alkali (as vasicin can be), they have left the question open.



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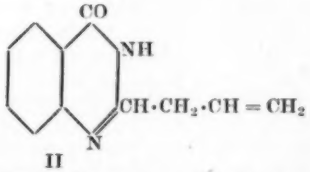


II

The main evidence on which the Späth-Nikawitz peganin formula rests is its oxidation to 4-oxyquinazoline 3-acetic acid whilst vasicin furnished 4-oxyquinazoline under similar conditions.

A sample of vasicin which was left for 2 years on examination has been found to have been considerably lowered in m.p. due no doubt to oxidation. Therefore, the question arises whether a similar partial oxidation could not have occurred in the isomerisation experiment described by Ghosh *et. al.* (*J.* 1932, 2740). Against this we have to contend the fact that *iso* vasicin does give a *hydrochloride* m.p. 222° considerably higher in m.p. than vasicin hydrochloride and a mixed m.p. also shows considerable depression. However, we are investigating this point further.

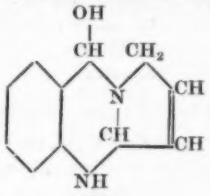
The structure for peganin was also considered by us for vasicin but was rejected on the following grounds:—

(*a*) Vasicin like many 4-oxyquinazolines remains dissolved in alkaline solution and is not precipitated till acidified with acetic acid. This is incompatible with structure I.

(*b*) Vasicin on interaction with acetic anhydride gives an acetyl derivative which is formed with the loss of a further molecule of water. On the basis of structure I such a dehydro-acetyl derivative cannot be formulated.

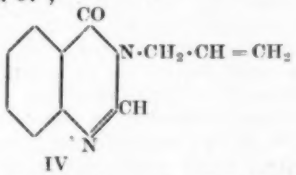
It is worthy of note that the acetyl derivative of peganin has been found to be an oil (*cf.*, Späth and Nikawitz, *loc. cit.*). This fact also points to the two alkaloids being different. If so, then it is most interesting to note how closely allied they are.

But on the basis of structure II, the formation of 4-oxyquinazoline 3-acetic acid can be explained if it is assumed that oxidation takes place *via* the intermediate III.



III

In order to verify the structure for peganin (I) we have recently prepared the substance IV, m.p. 67°,



IV

by the interaction of allyl iodide with 4-oxyquinazoline in alkaline medium. Following Bogert, the substance has been formulated as a N-alkyl and not an O-alkyl ether because it is undecomposed by boiling hydrochloric acid at 110° and also is non-volatile in steam (*cf.*, Bogert and May, *Jour. Amer. Chem. Soc.*, **31**, 508, 1909). Moreover another low melting substance is formed in the reaction which undoubtedly is the O-ether. The low m.p. of the substance is against the structure I for peganin.

Moreover, if peganin had been identical with vasicin, then the oxidation of this substance with hydrogen peroxide in acetone should give the two products, m.p. 168° and 212° isolated from vasicin under the same conditions. We have found that IV can be isolated entirely unchanged when oxidised by hydrogen peroxide in acetone under the conditions described by Ghosh *et. al.* (*loc. cit.*).

The reduction of the substance IV with amyl alcohol and sodium has given a substance B.P. 105-110°/3 mm. but unlike the very similar product from peganin (m.p. 69°·5) we have not yet been able to obtain it in a crystalline condition. Therefore, again, it seems that it is doubtful if peganin can be represented as I. We must state that the substance has a very characteristic odour reminiscent of the mother liquors in

the purification of crude vasicin which probably is also what Späth and Nikawitz mean by 'a characteristic odour'.

Our investigation would be published elsewhere in a more detailed form.

K. S. NARANG.
The University, J. N. RAY.
Lahore.

The Effect of Germination on the Reducing Power of *Phaseolus mung*.

SINCE the discovery that Szent-Györgyi's hexuronic acid or ascorbic acid is identical with vitamin C, the reducing property of ascorbic acid has been sought to be used as a measure of the vitamin C-content of natural food-stuffs.[1] The presence of other naturally occurring reducing substances like glutathione might be supposed to interfere with the specificity of this method of chemical assay. But substantial evidence[1] has been brought forward to show that this method is a fairly accurate one for nearly all the food-stuffs studied. It is known that vitamin C is produced during germination and that germinated *mung* (*Phaseolus mung*) is rich in vitamin C.[2] We have found that germination does indeed cause a six-fold increase in the reducing power of *mung*, calculated on the basis of dry weight. The reducing value was determined by titrating trichloracetic acid extracts of the germinated and ungerminated *mung* against 0·01 N Iodine as well as against the oxidation-reduction indicator 2:6–dichlorophenol indophenol (0·01 M). Harris and Ray[3] have also observed an increase in the reducing power of peas on germination. Johnson[4] has observed, however, that this increase in the reducing power of germinated peas is out of proportion to the increase in anti-scorbutic potency and concludes that a reducing substance besides ascorbic acid is produced during germination.

In estimating the reducing power by means of the indophenol indicator according to the technique of Tillmans, as modified by Birch, Harris and Ray,[1] it has been found that even dilute trichloracetic acid (0·5%) by itself decolorises the indicator. This decolorisation can be inhibited by the addition of glacial acetic acid to the indicator solution prior to titration by the trichloracetic acid extract. By means of this titration technique, a sample of red chillies has been found to have a reducing power of at least the same order as Hungarian paprika.

B. C. GUHA.
Biochemical Laboratory, A. R. GHOSH.
Bengal Chemical &
Pharmaceutical Works, Ltd.,
Calcutta,
March 7, 1934.

[1] Harris and Ray, *Biochem. J.*, **27**, 303, 1933; Birch, Harris and Ray, *Biochem. J.*, **27**, 590, 1933.
[2] Wats and Eyles, *Ind. J. Med. Res.*, **20**, 89, 1932.
[3] Harris and Ray, *Biochem. J.*, **27**, 580, 1933.
[4] Johnson, *Biochem. J.*, **27**, 1942, 1933.

Current Science and the Indian Academy of Sciences.

IN view of the recent publication of certain disputatious statements in the press regarding the institution of an Indian Academy of Sciences and the totally unexpected and embarrassing trend which the affairs have assumed, the Board of Editors, *Current Science*, desire to announce that the Journal, having taken the initiative in the proposal to establish such a foundation, now stands aside in a spirit of detachment. It will not lend its support to any movement which is apt to produce a factious spirit among the scientific workers, which must be absolutely fatal to the fundamental cause of progress in India. The policy of the Journal is to follow and promote peace, and in pursuance of this declared object, it will seek for opportunities to establish good understanding in all endeavours calculated to advance the higher destinies of science.

This policy of the Journal does not, however, impose restraints on the freedom of action on the part of the individual members of the Editorial Board as also those of the Board of Editorial Co-operation who may desire to participate in any particular movement and if and when they do so, they act either in their own private capacities or as members of some one or other of the scientific institutions favouring such a movement. The public utterances of such members or their action in the committees in which they choose to function, do not reflect the official views of the Journal.—ED.

Lt.-Col. R. B. S. Sewell, F.R.S.

CURRENT SCIENCE offers its hearty congratulations to Lieut.-Colonel Robert Beresford Seymour-Sewell on his selection as a Fellow by the Council of the Royal Society, London. He spent the best part of his life in India, first as an officer of the Indian Medical Service, later as the Surgeon Naturalist to the Marine Survey of India and finally as Director of the Zoological Survey of India; he went on leave preparatory to retirement from the 22nd April 1933. He was a member of the Editorial Board of the *Current Science* and gave us valuable help at all times and we are particularly glad to hear of his selection as a Fellow of the Royal Society, London.

Lt.-Col. R. Beresford Seymour-Sewell, M.A., Sc.D., F.Z.S., F.A.S.B., I.M.S., C.I.E., F.R.S.

Colonel Sewell has done very valuable work as a Zoologist, Oceanographer and Anthropologist and a detailed list of his papers was published in the *Records of the Indian Museum*, Vol. XXXV, pp. 270–275 (September 1933), while an account of his life was published in the *Current Science* issue for April 1933. We sincerely hope that the results of his investigations as the Leader of the John Murray Oceanographical Expedition will greatly add to our knowledge of the oceanography and fauna of the Arabian Sea.

Dr. L. L. Fermor, F.R.S.

WE record with genuine pleasure the election of Dr. L. L. Fermor to the Fellowship of the Royal Society. This has come as a fitting recognition of the long and devoted scientific labours of the present Chief of the Geological Survey of India. Dr. Fermor's connection with the Geological Survey dates from 1902 and throughout this long period, his work has been characterised by breadth of outlook and wide human sympathies side by side with mastery of detail and meticulous precision in the expression of scientific observations. Amidst his numerous contributions to Mineralogy, Petrology and Archæan Geology, perhaps the most outstanding work which will remain as a memorial to his ability and industry, is his monograph on the Manganese Ore Deposits of India dealing with every aspect, scientific and economic, of the subject.

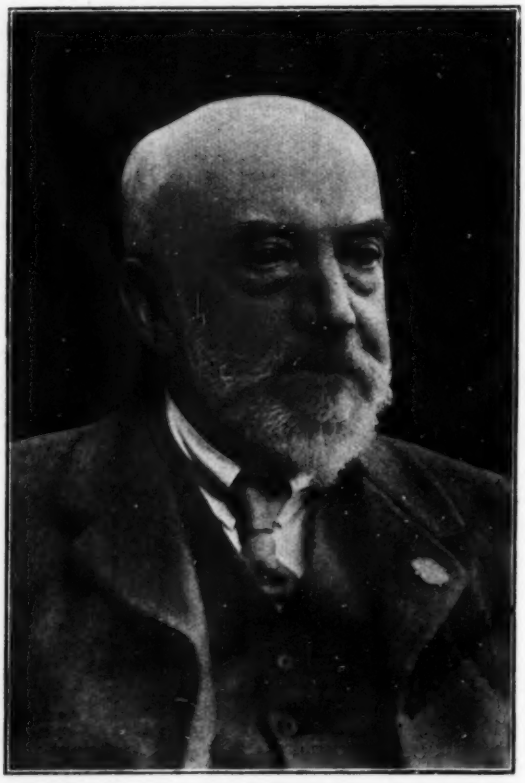
Dr. L. L. Fermor, O.B.E., D.Sc., F.G.S., F.R.S.

Dr. Fermor's social qualities are equally great; they find full play in his administrative duties, not only in his department, but also such institutions as the Asiatic Society of Bengal, of which he is the President, and of the Mining and Geological Institute of India, of which he is the Treasurer and Editor. A happy disposition, an even temper at all times and the capacity to understand and appreciate other points of view than his own, characterise his dealings with his official colleagues and non-official friends and acquaintances. We wish him long life and further honours.

Obituary.

Dr. Dukinfield Henry Scott.

DUKINFIELD HENRY SCOTT, F.R.S., died on the 29th January 1934 at the age of seventy-nine, after a remarkable career as an investigator spread over more than half a century. Born in London in November 1854 he was, till the time of his death, in full possession of his extraordinary vigour, producing, till as late as last year, work which involved a constant use of the microscope. For nearly thirty years after the death of Bernard Renault, he was the universally-acknowledged leader of the old anatomical school of palæobotanists, of which the foundations were laid just over a hundred years ago. With the passing of Dr. Scott is removed one of the last remaining links with the "old guard", who had helped the anatomical study of fossil plants to the high position it occupies to-day.



Apart from a few of his earliest works, which deal with the structure of living plants, Scott's original work lay entirely within the domain of Fossil Botany. After taking his B.A. degree at Oxford he worked for a Ph.D. for a couple of years under Sachs at Würzburg. In his dissertation, published in 1881, he described the development of laticiferous vessels and was able to show (without the use of a microtome) that they were formed by a fusion of specialised cells in the young tissues. His other notable works on living plants were a paper (with T. G. Hill, 1900) on *Isoetes* which confirmed the view that this aberrant genus is a reduced type of lycopod, without any special relationship to the ferns; and a slightly earlier paper (1897) on the vascular anatomy of the cone peduncles of the Cycadaceæ. In the latter, attention was drawn to the frequent occurrence of mesarch and concentric bundles; these fern-like features were till then known in the axial organs of only a very few living gymnosperms, though they had already been observed in several fossil types, such as *Lyginodendron* (now *Lyginopteris*), *Heterangium*, *Calamopitys* and others. Coming immediately after the Japanese discovery of ciliated sperms in *Cycas* and *Ginkgo* these facts seemed strongly to confirm the theory (which held almost undisputed ground until Scott himself relinquished it in 1919) that the Gymnosperms generally were derived from the ferns.

It was at Würzburg that Scott first met Goebel, of whom he writes: "I had a great regard for him from the first, both on his own account and because he was a pupil and ardent admirer of the great Hofmeister, who had long been my chief botanical hero." Those who have had the privilege of personal contact with both Goebel and Scott will appreciate the kinship as well as the contrast between these two leading spirits who, each in his own way, exercised such a marked influence upon the course of plant morphology. Botany has suffered sadly indeed to have lost both of them within about a year of each other.

It is a curious fact that practically the first that Scott had ever heard of fossil plants was, as he himself tells us, at Goebel's lectures at Würzburg; for Goebel, almost till the end of his life, evinced a strange antipathy against the study of fossils.[1] But it was not until ten years later that Scott seriously took to palæobotanical research. This was the prelude to that eventful though belated association with Williamson, who was already near the end of his brilliant career. Thenceforth, Scott was always "in the thick of it," and few have lived to witness such momentous developments in fossil botany or taken a more significant part in their shaping. That romantic quest after the "seed-ferns", and the question of their possible origin from the true ferns—in fact the origin of the seed-bearing plants as a whole—was the central pursuit of his long career, as it still remains one of the chief problems of Palæobotany to-day. In this, as in other directions, we are wiser now chiefly in a paradoxical sense: the progress of knowledge has but revealed our ignorance and the fallacy of our preconceived notions. In a remarkably frank statement published shortly after he had relinquished the idea of a filicinean origin for the seed-plants, he wrote: "It has been generally assumed, since Hofmeister's discoveries, that the seed-plants were derived from heterosporous Vascular Cryptogams.....The idea got abroad that the Pteridosperms were ferns which had become Spermophytes.... The present writer is one of those responsible for this interpretation of the facts.... On a review of the evidence it appears that this view is unjustified." And then he goes on to explain: "It is easy to see how the current idea arose. We used to believe that half the Carboniferous plants were Ferns. Then it turned out that many or most of these 'Ferns' bore seeds. Yet we could not get it out of our heads that they were Ferns after all—they were so like them. We should have remembered 'that every like is not the same!'" Simplicity and directness of style was a marked characteristic of this great writer.

Latterly he was engrossed with the old question as to whether certain synangium-bearing fronds (*Scolecopteris*, *Acitheca*, *Asterotheca*) belonged to Marattiaceæ or, as Kidston was inclined to believe, to seed-bearing plants. The question had recently been brought up in a critical form by Professor Halle's discovery of seed-bearing fronds of *Pecopteris wongii*, a Chinese species almost identical with the well-known *Pecopteris miltoni*, which bears fructifications of the *Asterotheca* type. Till the end, Scott was impressed by the Marattiaceous resemblances of *Scolecopteris* (1932, 1933), though he did not regard the question as closed. It is, however, significant of the marked change of outlook since the discovery of the first undoubted Pteridosperms, that even *Psaronius*, a plant so completely fern-like in its anatomy, cannot now be regarded as quite above suspicion in this respect.

It is impossible here to attempt anything like a fair estimate of the influence of Scott's career upon the progress of palæobotany. His original contributions dealt chiefly with the anatomy of palæozoic plants. This was in itself a vast field, but his breadth of outlook was better evidenced by his masterly reviews of contemporary work; for he was an acknowledged leader in the art of reviewing the situation whenever anything new had happened. Like all cautious workers he was difficult to convince, and in this sense he was a conservative but, as we all know, by no means of the type that clings to pet theories.

Scott's numerous special memoirs, some of which were published jointly (with Williamson, F. W. Oliver, Jeffrey and others) ranged through nearly all the important palæozoic groups, and several will rank among the classics of palæobotanical literature. The "seed-ferns" naturally claimed the largest attention: *Lagenostoma* (1904) and *Trigonocarpus* (1907); *Sutcliffia* (1906), *Medullosa* (1899, 1914) and the Heterangiums (1917); lastly, the Calamopityeæ (1914, 1918, 1924).

Substantial advances were also made in the Cordaitales (1902), in which important resemblances were demonstrated with the Cycadofilices, particularly in the genus *Mesoxylon* (1910, 1912, 1918). One of the most interesting discoveries (1919) was that of the fertile shoots of *M. multirame* which were shown to be essentially a *Cordaianthus*, possibly bearing seeds of the type already known as *Mitrospermum compressum*. Shoots of a similar nature were recently described under the new generic name *Gothania* by Hirmer, whose work confirmed the identification of these shoots as a *Cordaianthus*. In

[1] I believe it was Hirmer, now in Goebel's chair at Munich, who softened the latter towards palæobotany.

one of his last papers (1933) Scott reverted to that peculiar Lower Carboniferous genus *Archæopitys* Scott and Jeffrey (1914) founded nearly twenty years previously and forming, with *Pitys* and *Callixylon*, a compact little group provisionally included among the Cordaitales. Mention should also be made of the problematical shoots *Cladites bracteatus* (1930) which may eventually turn out to be the fertile shoots of another member of the Cordaiteæ.

On the Zygopterideæ the most notable papers were those on *Botrychioxylon* and *Zygopteris* (*Ankyropteris*) *Grayi*, both published in 1912. It was Scott's work on *Botrychioxylon* that first clearly indicated the Ophioglossaceous affinities of this family, already long suspected. The genus has since turned out to be very closely allied, if not identical, with the old genus *Zygopteris* of Corda. Scott was the first to demonstrate the sporangia of *Stauropteris*, a plant which had long been a puzzle to palæobotanists but is now, probably rightly, classed among the Zygopterideæ, though still as an aberrant member. This was in 1905, during those exciting years when the seed-ferns were rapidly emerging into recognition. One after another, several supposed ferns had been proved to be in reality seed-plants: *Lyginopteris oldhamia*, *Neuropteris heterophylla*, *Aneimites fertilis*, *Pecopteris pluckeneti*; while a host of others were already under suspicion. With these discoveries as a background it is easy to understand the caution with which Scott concluded his remarks on *Stauropteris*: "On present evidence the systematic position of *Stauropteris* must remain an open question. That it shows affinities with the Ferns is certain, but it would not be surprising to find that, like so many other Fern-like plants of its period, it had crossed the Spermophytic frontier, so that its sporangia ..... were in reality of the nature of pollen-sacs." Indeed, even to-day, if the truth must be confessed, the position remains essentially the same, for the petiolar anatomy of this, as of most other Zygopterideæ, is too distinct from anything we know among undoubted ferns to leave us in absolute security as to the real nature of these plants. Palæobotany is a veritable store-house of surprises, even for the wariest worker, as has been frequently witnessed during the life-time of D. H. Scott.

Special mention must also be made of Dr. Scott's memoirs on the spenophylls and on *Lepidocarpon*. In this direction, as in his work on the "seed-ferns", he proved a worthy successor to the great Williamson. The memoirs on *Cheirostrobus* (1897), *Lepidocarpon* (1901) and *Sphenophyllum fertile* (1905) bear testimony to his great skill in the elucidation of complex fossil structures, not often preserved under the most favourable conditions. At one time Scott shared the view (for which he was himself largely responsible) that the modern Psilotaceæ were the nearest known relations of the sphenophylls. But we all know the reaction which the Rhynie discoveries brought about in his attitude on this question.

It is difficult to say whether Scott's work was great chiefly on account of his brilliant expositions of the structure of extinct plants or because of his more general, synthetic, writings in which, with the skill of a great painter, he recorded from time to time the repercussions of current work upon the theoretical background of Palæobotany. But all will agree that he was a writer with a rare gift, which he displayed alike in that elementary text-book, "Structural Botany" as in his classical "Studies in Fossil Botany" undoubtedly his greatest work. In "Extinct Plants and Problems of Evolution" (1924), an authoritative summary remarkable for its clarity and perspective, are recorded what may be taken as his latest views on the broader questions of phylogeny.

Scott was not a voluminous writer, but his writings had the impress of sound judgment, based upon a strict adherence to

facts. He has left a fine monument of original work, which he built nobly, in the true spirit of Science, with no claim to finality. There is a certain element of triumph in a bold recantation of long-cherished ideas, and that triumph probably

few men of Science knew better how to win than Scott. The following words of Alexander Pope, which Dr. Scott was fond of quoting, truly describe his own attitude of mind:

"And spight of pride, in erring reason's spight,
One truth is clear; whatever *is*, is *Right*.'

Of his personal qualities, and of the reminiscences of the 'grand old man', let the elders speak, for that is their privilege. This little sketch is a slight tribute from one who, working in distant isolation, received from him much kindness and inspiration in a field of research which he so richly adorned.

The portrait is reproduced from a photograph dated Liverpool, September 1923. The snapshot, with G. R. Wieland on the left, was taken at Cambridge in August 1930, on the occasion of the Fifth International Botanical Congress. Those who attended the Palæobotanical Section under the inspiring presidency of Dr. Scott will recall happy memories of an unusually successful meeting.

B. SAHNI.

Lucknow, India,
March 1934.

An Automatic Electric Tower Clock Made in India.

By Dr. H. P. Waran, M.A., Ph.D., D.Sc., F.Inst.P.
Presidency College, Madras.

THE science of Horology (clock making) is one of those departments of applied physics which has had scant development in India. May be, it is because of a belief that it is a specialised line to which large industrial concerns have devoted themselves on mass production lines in the West and hence out of reach of small-scale individual effort. However, the fact remains that it is a subject receiving no attention whatever at the hands of our routine laboratory physicists. This is really deplorable as a physics laboratory and the average workers in it can contribute so much to the science of horology if only they will turn their mathematical, experimental or technical resources to this fascinating and useful study.

The work on large clocks of the type put up on towers for supplying accurate time to the public does certainly border on heavy engineering. But the smaller sizes of such clocks are certainly not beyond the capacities of any average physics laboratory equipped as most of them are with a workshop for the repair and manufacture of scientific instruments. The average physicist, however, seldom realises how interesting the design and construction of such clocks can be and what excellent opportunities there are in this domain for the exercise of all his faculties. Even if one considers only the single factor of costs the very large savings one is able to effect in these days of economy by making the clock oneself ought to recommend such activities to institutions in need of such services. At a modest estimate the saving works out at about 75% of the commercial quotation.

In recent years electricity coming to the aid of man has found extensive application in horology and many are the systems in vogue now by which large clocks are rendered quite automatic in action. One such clock of novel design, constructed at the Presidency College in 1930, has already established its reputation by its excellent performance for the last three years and it is shown in Fig. 1.

The clock has an illuminated dial six feet in diameter the frame being of cast iron one inch thick with a central star shaped webbing to stand the heavy wind thrust in the exposed situation right opposite the sea. The panels are filled with plate glass $\frac{1}{4}$" thick frosted and painted inside with white enamel to get a translucent finish. The hands are of ribbed aluminium casting $\frac{1}{8}$" in thickness and four inches wide each weighing about 2 lbs.

The interesting novel features incorporated in the design of this clock are the following indicated in Figs. 2 and 3 which are line drawings showing the circuit details for purposes of explanation only.

The isochronism of the pendulum is ensured by the employment of a gravity lever escapement Fig. 2. This being new to many physics people may require an explanation.

The driving weight of about 100 lbs. is urging the escape wheel W to rotate in the direction of the arrow and it is prevented

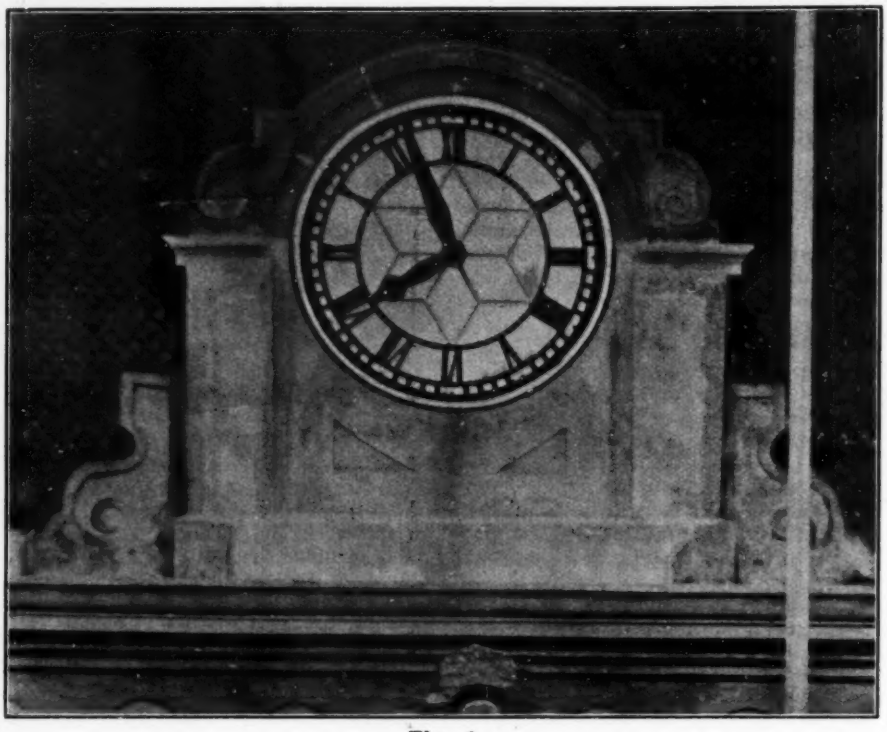


Fig. 1.

from doing so by its projecting tongue T resting against the steel check C, carried by the bent gravity lever L. The pendulum rod P moving in the direction of the arrow pushes out the gravity lever pivoted about Q until T escapes fast C. This rotation brings a steel pin R to press against a steel blade S carried by the gravity lever L. In this operation the driving weight lifts the gravity lever L and thus stores energy in it. When the pendulum returns this energy is given to the pendulum to keep up its arc of swing and ensure isochronism. There is symmetrical gravity lever L, on the other side of the pendulum for the same purpose.

The temperature compensation is automatically taken care of by the pendulum rod being of Invar. Its residual temperature coefficient has been carefully measured and compensated for by a small cylinder of aluminium supporting the 100 lb. cast iron bole twelve inches in diameter.

The noisy recoil of the escapement on impact against the arresting cheeks on the gravity levers is generally an objectional feature of this escapement. The recoil tends to reverse the train and the slight rolling action results in gradual wearing off the gear teeth. This is usually prevented to some extent by a large fan fly which makes the design cumbersome. In the present design it is taken care of by what may be termed an inertia wheel which being new to horological practice may require some explanation.

This is illustrated in Fig. 2 B and it is a small bronze fly wheel F about 4" in diameter fitted loose on the escape wheel shaft S. Two springs r and r' from the rim of this wheel carry friction blocks of fibre B and B' and they pinch the escapement shaft between them with adjustable friction. Now if the escapement is released and it tries to rotate rapidly the inertia of the wheel steadies it and prevents it acquiring a large angular velocity. On its sudden arrestment the wheel slips on its axle keeping a forward urge on the shaft so that a recoil of the

escapement is impossible. The improvement is markedly noticeable in the very much reduced noise at impact and the horrors of this noisy escapement which makes the adjoining rooms generally unusable are prevented. Because of this new device the usual wind vane or fly of about four feet diameter is absent and it enables the mechanism to be kept very compact.

The drive is by a gravity weight W of about 100 lbs. hung on to the loop of an endless chain going over an 8″ diameter sprocket wheel S keyed on to the minute hand shaft going round once in an hour as shown in Fig. 3. The other end passes round a sprocket Ś, keyed on to the shaft of a worm gear actuated by a ¼H.P. electric motor. The slack portion of the chain hangs outside as a loop carrying a small weight W′ to keep the chain tant. Because of this modified form of Huygens chain drive, not only maintaining power while the clock is being wound up automatically is ensured but also the arrangement permits of the maximum available fall being effectively utilised. This height being limited to about 4 feet which is all that is available in the window space of the college tower, an automatic winding up of the weight every hour (after a foot fall) is arranged. This makes this design of clock particularly suitable for location inside the circular opening in the wall of a tower made for the large dial.

The automatic winding every hour operates as follows :—The falling driving weight W, has a projecting arm A, which after an hour of fall rests against a lever L and lowers its end E. The lever being pivoted (with some friction at the pivot) the other end E′ is raised and this end being coupled to lever F by a connecting rod R, the end F′ is raised and the end F lowered. This end carries a mercury switch and the mercury flows down to make contact between the two pools p and p' and starts the winding motor M. Since the motor is coupled to the winding sprocket by a double reduction gear of ratio 1 : 1200 there is ample reserve of power and the weight is smoothly wound up without any effort. The arm A coming up against the lever end F raises it and the mercury switch having gone fast the horizontal the excess mercury flows away breaking contact between the two mercury

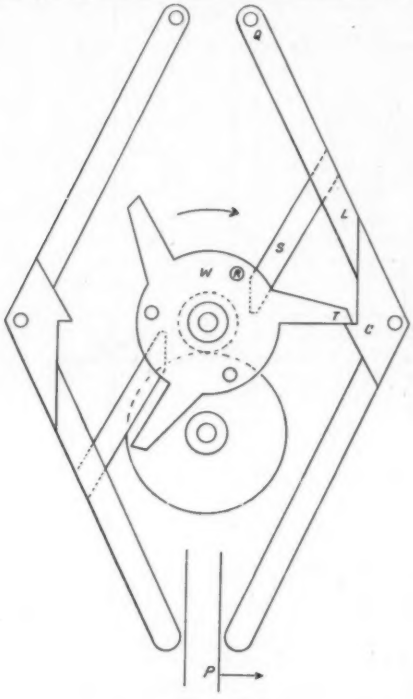


Fig. 2 A.

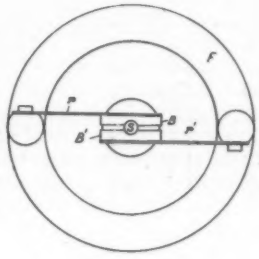


Fig. 2 B.

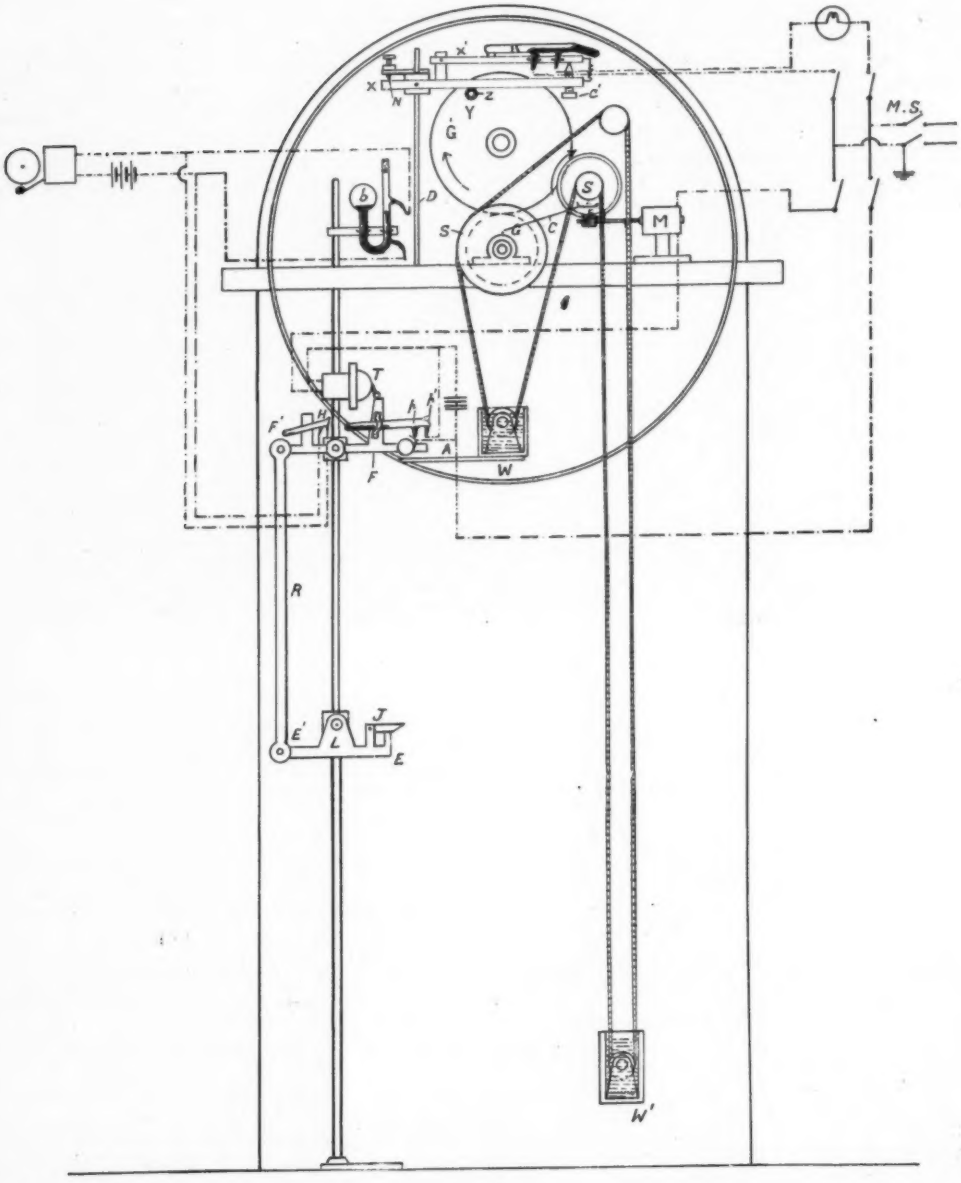


Fig. 3.

pools. This stops the motor. Thus the clock is quite automatic in action requiring nothing but a monthly attention for oiling and adjustment of any residual errors. Even this oiling is made automatic as the chain passes through oil baths in the driving weight and counterweight chambers. Every hour as the winding takes place the chain brings up oil to the winding sprocket S'. Dripping from there the oil is caught in a shallow tray *t* from which copper tubes lead the oil to the essential bearings.

The under dial system of gears to reduce the minute hand motion to the hour hand motion of 1/12 is made as a separate system of four gears running in an oil bath mounted on a separate girder. The coupling between the clock and this part is by a positive acting clutch of novel design. This facilitates not only the setting of the hands by minutes without stopping the clock but any difference of alignment between the two parts is also made innocuous at this flexible but positive drive existing at the clutch.

Provision is also made for the automatic lighting up of the dial at about 6 P.M. every day, the light being automatically cut off every evening at about 10 P.M. and thus save the lighting cost which is about ten times the winding cost. This is achieved as follows:—

The hour hand shaft that rotates once in twelve hours carries on it a gear G which engages with another gear G' of double the number of teeth. This, therefore, rotates once in a day. It carries on its rim a roller Z round a pin Y. During the rotation of the wheel this roller comes up against a pivoted lever X carrying a mercury contact in the lighting circuit as shown. Normally the lever X rests against a screw point N which keeps it horizontal. This lever carries a subsidiary lever X' which is the one carrying the contact. The screw C' against which X' rests enables adjustment of the mercury contact to be made. These are so made and the wheel G' so set that as the roller comes up and raises the lever the contact is closed exactly at 6 P.M. As the wheel G' rotates the lever is kept tilted up and the mercury contact is kept closed. The roller passes the highest point at 8 P.M. and by 10 P.M. the roller has lowered the lever to horizontal again breaking the lighting circuit. Thus the duration and time of lighting and cutting off are all adjustable to suit individual requirements.

It is interesting to note that this arrangement gives also an amount of automatic connection for the changes in the lighting up time with the seasons. In tropics at any rate where the magnitude of this is not very large it seems to work. The rod D carrying the switch lever changes in height with the change of temperature accompanying the seasons and to that extent it alters the time at which the contact closes. Thus in summer with the prevailing higher mean temperature the rod elongates enough to advance the lighting up time. The reverse happens in winter because of the lowering mean temperature.

Every such clock even though well designed and executed with every care must have incorporated in it many safety features if trouble is not to be experienced sooner or later.

Thus the mercury contacts may arc and overwinding may result with damage to the winding gear and motor. This is provided against by the knob of the main switch T being placed just above the lever F. If the lever rises beyond its set limit by the mercury contact arcing, the main switch gets thrown off mechanically. Precautions against such arcing or failure to make contact are taken by the contact being of the mercury type in an atmosphere of low pressure Hydrogen, shunted by large condensers to quench any tendency to arc.

Whenever the main switch (mechanical) thus gets thrown off by overwinding the increased inclination of the lever F results in the closing of a mercury contact—(not shown) which closes the circuit of an electric bell placed in the office below attracting immediate attention to this state of affairs. It could be looked into and repaired at once.

Another possible trouble specially to be guarded against in electric clocks run off public supply mains is that arising from the failure of the supply occasionally for a few minutes or hours. This is incidental to even the best of public supply systems and in the present design it is guarded against as follows. Failure of the supply for a few minutes is certainly of no consequence as the drive is by gravity weight. This failure may occur just when the arm A has lowered the lever E and the winding contact has not yet closed. The result is the lever A passes the lever E leaving it in the inclined position of contact made and using the reserve fall of about 3 feet the clock can still go on for three hours. During this the

power is sure to return and since the contact is left on the motor can wind up the driving weight. There is the provision of a passing lever J on E so that the arm A may go up lifting it and not E. The extreme inclination at which the levers are left closes a mercury contact at H which operates the electric bell down below calling attention to this state of affairs. The bell continues to ring until this situation is taken in hand. Since this warning is given full three hours before the clock has to stop there is ample time to effect repairs.

Since the mains have to be left alive day and night in such a clock tower it was thought advisable to instal an automatic fire alarm as well if ever the temperature in clock chamber rises beyond 50°C. This is done by the air contained in the bulb *b* expanding and closing the bell circuit again as indicated and the main switch M.S. supplying power to the tower could be taken off.

Provision is also made for this clock to switch on automatically the electric bells by which the class periods are signalled in the college now. The details of this together with the bell ringing for chiming out the time on a large bell are reserved for the next article.

Conversazione on the Occasion of the 150th Anniversary of Foundation of the Asiatic Society of Bengal.

THE Conversazione on the 15th January, 1934, in connection with the 150th Anniversary of Foundation of the Asiatic Society of Bengal was a brilliant function. It was held in the spacious upper verandahs of the Indian Museum which were divided into compartments to hold exhibits, and were illuminated by means of strong lights. Arrangements were also made for an At Home with Indian Music for about 500 guests on the lawn of the Museum. The guests were received by the President, Dr. L. L. Fermor, and Dr. S. L. Hora, the Secretary of the Jubilee Celebration Committee. A 'List of Exhibits' and a small pamphlet by Dr. A. M. Heron of the Asiatic Society of Bengal were handed to each guest. The exhibits were tastefully laid out and comprised all branches of Letters and Science. Through the courtesy of the Academy of Fine Arts, Calcutta, some fine paintings were on view and added a great charm to the other exhibits. The Imperial Records Department put up a series of old documents of great public interest. The Archæological Section of the Indian Museum and Dr. S. K. Chatterji exhibited a series of archæological finds, some of which constituted recent discoveries and were exhibited to the public for the first time. A numismatic exhibit was provided in the form of a show-case containing specimens of coins, medals and decorations struck at His Majesty's Mint, Calcutta. The Departments of Chemistry and Physics of the University of Calcutta gave some interesting demonstrations of certain chemical and physical phenomena, such as Brownian Movement, Active Charcoal, Wireless Echos, Dyes, etc. The Geological Survey of India exhibited palæontological specimens and of these the fossilised remains of Dinosaurian Reptiles deserve special mention. Mineral and Rock exhibits were also shown by the department. The Botanical Survey of India showed original paintings of plants by William Roxburgh, Wallich's Catalogue, coloured sketches of some plants under cultivation at the Royal Botanical Garden, Calcutta, and Narayanswami's manuscript of a comprehensive catalogue of references to all works dealing with Indian Botany. Dr. S. C. Law exhibited Habitat Groups of bird-life in Bengal, drawings of some Indian Birds and photographs of his wonderful aviaries at Agarpara. The Zoological Survey of India put up ethnographical and zoological exhibits of great interest, and the School of Tropical Medicine had some very instructive exhibits dealing with Protozoology, Helminthology, Entomology, Rabies, Bacteriology, Indigenous Drugs, Filariasis, Kala-Azar, Leprosy and Public Health. A most useful feature of the Conversazione was the presence of qualified demonstrators in each section enabling the guests to take an intelligent interest in the exhibits and to elicit more information, if desired, than what had been supplied to them in the 'List of Exhibits'.

The exhibits were thrown open to the general public for two days and were greatly appreciated.

Research Notes.

Induced Radioactivity.

IN the *Comptes Rendus*, **198**, p. 254 and p. 559, 1934, *Mme.* Iréne Curie and *M.* F. Joliot describe some extremely interesting experiments on the artificial production of new radioactive elements. They had previously found (*Comptes Rendus*, **196**, 1885, 1933) that some light elements such as beryllium, boron and aluminium emit positive electrons when bombarded by α-rays from polonium. According to their interpretation the positrons from beryllium must be due to the internal conversion of γ-rays into matter, whereas in the case of B and Al the positrons must be due to a process of transmutation accompanying the emission of neutrons. In the course of further study they discovered the interesting fact that the emission of positrons continued for an appreciable time after irradiation with α-rays had been stopped and that the intensity of this positron emission decreased exponentially, showing *different* periods, as in the case of the radioactive elements. The periods thus found were 3 min. 15 sec., 14 min., and 2 min. 30 sec., respectively for Al, B and Mg. The elements H, Li, C, Be, N, O, F, Na, Ca, Ni, Ag showed no such activity. In some of these cases there might be no activity at all, while in others the period is too short.

The explanation given by Curie and Joliot is as follows: in the case of Al the reaction represented by the equation

$$Al_{13}^{27} + He_2^4 \rightarrow P_{15}^{30} + n_0^1$$

takes place, *i.e.*, the α-particle is captured by the Al nucleus resulting in the formation of P^{30} and emission of a neutron. The P^{30} nucleus is, however, unstable and disintegrates according to the equation

$$P_{15}^{30} \rightarrow Si_{14}^{30} + E^+.$$

The corresponding equations in the case of B and Mg are

$$B_5^{10} + He_2^4 \rightarrow N_7^{13} + n_0^1; \quad N_7^{13} \rightarrow C_6^{13} + E^+$$
$$Mg_{12}^{24} + He_2^4 \rightarrow Si_{14}^{27} + n_0^1; \quad Si_{14}^{27} \rightarrow Al_{13}^{27} + E^+.$$

In support of their explanation, Curie and Joliot have chemically proved the existence of Nitrogen and Phosphorus in the activated samples of Boron and Aluminium and they have also shown that the activity is due to the Nitrogen and Phosphorus thus proved to exist. This is the first time that a nuclear reaction expected according to considerations of energy has been chemically verified, since in previous cases of artificial disintegration, the process was instantaneous and gave rise to stable nuclei. The elements N_7^{13}, P_{15}^{30} and Si_{14}^{27} thus artificially produced and shown to be radioactive have been named respectively radio-nitrogen, radio-phosphorus and radio-silicon by the discoverers.

Very recently L. Meitner (*Naturwiss*, **22**, 172, 1934) has studied the transformation in Al by means of the Wilson camera and has shown that Al disintegrates in two ways under bombardment with polonium α-rays, *viz.*, according to the schemes

$$Al_{13}^{27} + He_2^4 \rightarrow Si_{14}^{30} + H_1^1 \text{ and}$$
$$Al_{13}^{27} + He_2^4 \rightarrow Si_{14}^{30} + n_0^1 + E^+$$

which is the one considered above.

Meitner has also shown that the frequency of the first of the above kinds of transformation is about four times that of the second.

Endocrine Control of Ovarian Functions.

C. W. BELLERBY (*Biochem. Jour.*, **27**, No. 6) has substituted very profitably *Rana temporaria* and *Xenopus lævis* in place of mammals for determining the action of the pituitary extracts on the activity of the Ovary. It is noticed that in the two amphibians, the pituitary is easily accessible. In the first place alkaline extracts of the anterior lobe pituitary have the same effects as acid extracts. This is a fact of some importance as it has till now been assumed that there are two distinct substances in the extracts which perform two different functions, *i.e.*, follicular growth and luteinisation. It is on the other hand more likely that we are dealing with a single substance which produces results apparently antagonistic. Bellerby is inclined towards the latter hypothesis.

Urinary Excretion of Vitamin C.

THE paper by L. J. Harris, S. N. Ray and A. Ward (*Biochem. Jour.*, **27**, No. 6) has probably great applications for dietetics. By the titration method with 2: 6 dichlorophenolindophenol they have demonstrated the presence of vitamin C in human urine and have found that in normal individuals, the daily loss of vitamin C in urine is about 30–33 mg. which is really a little greater than the reputed quantity required by man. It is interesting to note that in the case of

an individual who has imbibed a single large dose of vitamin C (about 600 c.c. of orange juice) the concentration of vitamin C in the urine rises very rapidly reaching in about three hours the maximum, which is nearly 10 times the normal. A rapid fall ensues and even if the subject is kept free from vitamin C diet for a week or more, the daily quantity of about 33 mg. is maintained.

Germination of Seeds.

THE influence of electrolytes and non-electrolytes on germination and the subsequent development of seeds is a fascinating subject which is just attracting the attention of plant physiologists. I. A. Volkov (*Bull. Appl. Bot. Gen. Plant Breeding*, III Series, No. 3, p. 131, 1933) has investigated the influence of sugar solutions and glycerine in the germination of different seeds of agricultural importance. In *Avena byzantina* the several phases were accelerated by more than a week, increasing simultaneously the dry matter content. The strongest effect was noticed in solutions of 0·4 N sucrose and 0·5 N glycerine. The effect is less marked with wheat, while the stimulating action on the flax seeds was practically nothing. The author concludes that one of the factors which accelerate reproduction in the cereals is the accumulation of sugars. The seeds of oleiferous plants germinate equally well in water and in glycerine.

Drought Resistance in Fruit Trees.

WATER supply is one of the chief factors controlling plant growth. In the absence of moisture in the soil, the development of plants is enormously modified leading finally to their death. But it often happens that the soil holds moisture in insufficient quantities, leading to a condition, known as soil drought. The capacity of plants to grow in such cases is varied. An interesting contribution on the ability of fruit trees to withstand such drought has been made by A. Richter (*Bull. Appl. Bot. Gen. Plant Breeding*, III Ser., No. 3, p. 189, 1933). The author has adopted the wilting method successfully wherein the plants are kept at the hygroscopic moisture content of the soil for 8–10 days, and subsequently allowed to recover. Different plants lose different amounts of moisture under such treatments. The author tried the peach, the plum, the prune, the apricot, the cherry, the fig and the almond plants.

Striking morphological adaptations are noticed in the foliage of those plants. In one set, consisting of the peach, plum, apricot and some varieties of prunes, the leaves are found to withstand considerable moisture deficiency, without exhibiting any diminution in the transpiration surface, in such a case it is but natural that the rate of transpiration is considerably lessened. In the other set, comprising of the almond, the fig, the sweet cherry and one variety of prune, the foliage cannot support such a deficit and consequently the leaves drop off decreasing the transpiration surface enormously—a feature which is so common in the desert plants. The manifestation of either of this property is little influenced by the developmental phase of the plant either vegetative or resting.

The author has arranged as follows the stock of the fruit trees examined in the order of their resistance to soil drought: (*a*) the most resistant—the fig, the almond and the peach; (*b*) less resistant—a variety of prune, *Prunus Mahaleb* and the sweet cherry; (*c*) poorly resistant—*Prunus divaricata*, *P. spinosa* and the plum; and (*d*) highly susceptible to drought—the apricot.

The significance of such studies cannot be ignored for a tropical country like India, where the weather conditions are so varied.

Classification, Bionomics and Evolution of Homalopterid Fishes.

DR. SUNDER LAL HORA has made a signal contribution to our knowledge of the fishes of India by bringing out his extensive monograph on the Homalopterid fishes (*Memoirs of the Indian Museum*, **XII**, No. 2. pp. 263–330). Much of his recent work has centred round the extensive examination of torrential and mountain-stream-dwelling fauna and Homalopterid fishes constitute an important portion of this fauna. The first part of this work deals with the classification of the family where all the species have been described. The family is divided into two sub-families—Homalopterinæ and Gastromyzoninæ. There are six genera in the first sub-family and eleven in the second. The diagnostic characters of all the genera are tabled and they will doubtless prove of valuable assistance to every worker on Homalopterids. Several new genera have been described by the author,—Protomyzon,

Annamia, Sewellia, Vanmanenia and Beaufortia.

The second part of the work deals with the bionomics and evolution of the family. On account of the peculiar habits of these fishes which live in fast-flowing mountain torrents, clinging to rocks, several interesting modifications have arisen; the body has become flattened dorsoventrally, the scales on the under-surface have become reduced or are completely absent, and the paired fins have become modified in a remarkable manner to aid in the adhesion of the animals to the substratum. It is noticed that these modifications have arisen independently in the two different subfamilies, consequent on the assumption of the habit of living in the fast-flowing torrential streams. The respiratory and feeding mechanisms are remarkable, having been modified to suit the peculiar environment.

The Hyoid and Larynx of the Anura.

THE study of the amphibian larynx has been engaging the attention of workers from a long time and very recently W. Blume extended our knowledge on the microscopic anatomy of this structure in anura by publishing an exhaustive contribution in *Morph. Jahrb.* (Dec. 1930). No doubt this subject is a very fascinating study. Since the variations noticed in this extremely plastic structure are so many, we may not be correct in taking into account the morphology of this structure for purposes of classification of this group. The latest contribution to the gross anatomy of the larynx and hyoid is by Miss E. Trewavas (*Phil. Trans. Roy. Soc., Lond.*, B. 222, 1933) whose paper fills a large gap in our knowledge of the comparative anatomy of the larynx. She has studied many genera belonging to the different orders of the group anura and has given a comprehensive account of the larynx and hyoid apparatus in them including the South American form *Leptodactylus ocellatus*, which she treats as a generalised form. The description given for this and also for that of *L. prognathus* closely corresponds to that given for *Rana* by previous workers. In the other species of *Leptodactylus*, *viz.*, *L. caliginosus*, the cricoid annulus is incomplete ventrally with the low cardiac process separated by a gap. Moreover, the œsophageal process is exceedingly short in the female.

Similar variations both in the disposition of the muscles of the hyoid and the structure of the larynx have been described in other forms. Describing the group Pelobatidæ the author reports that the hyoid musculature resembles very closely the generalised Leptodactylid or Ranid type and supports the thesis that Pelobatidæ marks a distinct advance over the Liopelmidæ and Discoglossidae. Further, the incompleteness of the cricoid annulus among the Pelobatid examples studied by Miss E. Trewavas recalls the condition in some species of Leptodactylidæ. In *Rhacophorus dennysi* also, the same incompleteness prevails and it is surmised that this is a case of convergence of features. In one of the examples of the group Leptodactylidæ, *Crinia*, an intimate union of the cricoid annulus with the cartilaginous epiphysis of the posterior cornu of the hyoid is described. This feature is also noticed very pronouncedly in the examples of the group Brachycephalidæ and to a much less extent among the species of Bufo. An examination of both *B. himalayanus* and the more common *B. melanostictus*, will reveal that, at the outset, the union is not so close in these Bufonid examples as in the Brachycephalidæ but to a lesser extent. It is easier to remove the larynx from the fork of the posterior cornu of the hyoid in *B. melanostictus* than in *B. himalayanus*. On page 455, the author while describing the larynx of Bufonid examples gives under the title of *Bufo himalayanus* four sectional views of the larynx of the metamorphosing toadlet. In a footnote on the same page she reports about the sections thus, 'They were labelled *B. melanostictus*, but since the specimen came from India, they are more probably *B. himalayanus*.' This is not so, for the more commonly distributed form throughout India is *B. melanostictus* and Boulenger points out that *B. himalayanus* is restricted to Himalayas (Nepal and Sikkim).

The vocal organ of the examined species of *Rana*, *Megalixalus* and *Rhacophorus* is built on a common plan. They all possess the apical cartilage though not in many cases separately, from the arytenoids. The shape of the cricoid varies among the many species of *Rana* but invariably the females are characterised by the possession of the œsophageal process. No doubt there are certain exceptions as for example the males of *R. greyi* and some specimens of *R. breviceps* that are endowed with this process.

The separation of Cacosternum from the Brevicipitid group and its treatment under

a separate category is thoughtfully done. We learn from a study of the cranial osteology that this animal could no longer be brigaded under the Engystomatidæ and should be more correctly treated under Ranidæ. Most of the characters described for the group Brevicipitidæ have already been given in a paper published in the *Half-Yearly Journal of the Mysore University* (L. S. Ramaswami, *Journ. Mys. Uni.*, **6**, No. 1, 1932). The peculiar possession of a bony or cartilaginous median portion of the hyoid, the absence of the apical cartilage and the œsophageal process, the peculiar expansions of the terminals of the broncheal process have already been noted. At any rate, the absence of an omohyoid, the presence of only two petrohyoidei muscles are new. Except Hemisus and Breviceps, there seems to be a fundamental unity of characters underlying all the members of the Brevicipitidæ.

There still remains a large number of genera to be examined and the histological details would be extremely interesting and perhaps might reveal many new features.

——— L. S. R.

The United Provinces Grid.

THE further installations of low-head, slow-speed, vertical propeller type turbines at Bahadrabad and Bhola Falls in the Ganges Canal and the speculative proposition of harnessing the Sarda Canal for electrical energy purposes, to complete a grid, spreading all over a purely agricultural province with hardly any concentrated industrial loads has fulfilled the expectations of the Government in the direction of rural electrification. The existing Ganges Canal hydro-electric scheme started in 1928 has succeeded by 1931 in exploiting the water power resources of a number of low head falls to the extent of 5700 KW, which was continually going to waste in the irrigation canals of the province. The canal is 163 miles long between its head-works at Hardwar and Sumera Falls—the last fall in the Canal. The country has an average gradient of one foot per mile and this slope has been absorbed in a series of thirteen falls of heights ranging from twenty to nine feet. The ultimate total capacity when the scheme is completed will be about 30,000 KW. The four falls out of these have been harnessed as follows:—

No.	Distance from Head-works (Miles)	Generating Station	Head used (feet)	No. of turbine sets	KW.	Quantity of water required (Cusecs)
1	7	Bahadrabad Falls	19	4	2400	4000
2	84	Bhola Falls	15	4	1500	1700
3	148	Palra Falls	8	3	600	1200
4	163	Sumera Falls	14	2	1200	1000

The transmission grid includes these four generating stations, about 1000 miles of h.t. lines and 90 transformer stations and it has been so interlinked that uninterrupted and efficient service can be maintained even when there is a shut down of any one station. The energy is consumed by (1) the districts of Bijnor, Moradabad, Sahranpur, Muzaffarnagar, Meerut, Bulandarshahr and Aligarh; (2) Pumping stations at Ramganga and Kalinadi for pumping 300 cusecs of water to irrigate 80,000 acres of land; (3) Agricultural and rural industrial loads. The main transmission voltage is 37 KV. and also includes a portion of double circuit. The branch lines operate at 11 KV. and they have cost Rs. 8,800 and Rs. 4,000 per mile respectively and still cheaper rural lines are being erected and they compare favourably with lines of similar capacity hitherto constructed elsewhere. In the design of the grid, allowances have been made for future growth of load. The distribution has been left to the private companies. In spite of this elaborate network, this scheme is serving a total urban population of 952,000 at a sufficiently cheap rate and even cheaper to the rural industries. The novel engineering feature of the enterprise is the installation of generators on the existing foundations instead of on a detached one which has considerably reduced the initial expenditure. The total capital cost amounted to about Rs. 150 lakhs and the gross revenue has increased from Rs. 7½ lakhs in 1932 to Rs. 10 lakhs in 1933.

Another distinctive feature of this scheme is that it will incur additional capital expenditure only when a corresponding guaranteed demand arises. If need be, a similar scheme may be successful in later years in harnessing the Jumna Canal.

T. D. CHATTERJI.

Science News.

New Fellows of the Royal Society.—We are glad to announce that Dr. L. L. Fermor, O.B.E., D.Sc., F.G.S., Director, Geological Survey of India, and Lt.-Col. R. B. Seymour-Sewell, M.A., Sc.D., F.Z.S., F.A.S.B., I.M.S., C.I.E., Leader of the John Murray Expedition to the Arabian Sea, formerly (1925-33) Director, Zoological Survey of India, have been elected Fellows of the Royal Society. Both the distinguished scientists are on the Board of Editorial Co-operation of *Current Science* and we offer them our felicitations for the well-merited distinctions they have won.

* * *

Fellows of the Royal Society of Edinburgh.—Dr. R. M. Gorrie, Forest Research Institute, Dehra Dun, U.P., Prof. A. R. Normand, Department of Chemistry, Wilson College, Bombay; and Prof. R. K. Pal, Professor of Physiology, Prince of Wales Medical College, Patna, have been elected Ordinary Fellows of the Royal Society of Edinburgh at its meeting held on the 5th March 1934.

* * *

Back Grant Award.—The Royal Geographical Society, London, announces the Back Grant Award to Mr. D. N. Wadia for his studies on the geomorphology of the Himalayan regions. Mr. Wadia's researches have already earned for him numerous distinctions and we hope that greater honours are in store for him.

The Royal Geographical Society has awarded a medal to Mr. Hugh Rutledge. We have pleasure in offering our felicitations both to Mr. Wadia and to Mr. Rutledge.

* * *

International Congress of Radiobiology.—Sir C. V. Raman, Kt., F.R.S., N.L., Director, Indian Institute of Science, Bangalore, has been invited to deliver the Inaugural Address at the First International Congress of Radiobiology which will be held in the historical palace of the Doges of Venice (Italy) on the 10th September.

The Council of the Indian Institute of Science have sanctioned Sir C. V. Raman being placed on special deputation out of India for this purpose. Dr. Raman will visit some of the chief centres where Research work on atomic disintegration is being carried out.

* * *

President of the British Association, 1934.—At the recent meeting of the General Committee held on the 2nd March, Sir James Jeans has been elected President of the British Association. He will preside over the meeting which will be held at Aberdeen in September.

* * *

The Budapest International Fair, 1934.—The Fair will be held this year from the 4th to the 14th May under the auspices of the Budapest Chamber of Commerce and Industry. Firms intending to participate in the Fair may obtain full particulars from Mr. Eugen Ludvig, c/o Post Box No. 60, Madras, who is the representative of the Fair in India.

* * *

The Bangalore Easter Science Congress, 1934.—Under the joint auspices of the Association of Economic Biologists, Coimbatore, Indian Chemical Society (Madras Branch), Institute of Chemistry (Indian Branch), Society of Biological Chemists, India, and the South Indian Science Association, Bangalore, a Science Congress was held from 30th March to 2nd April, Sir C. V. Raman, Kt., F.R.S., N.L., presiding.

Delegates from Coimbatore, Madras and Travancore attended the Congress. Sir C. V. Raman delivered the inaugural address on "The Study of Scattering of Light in relation to Chemistry"—33 papers came up for discussion before the meeting. An interesting feature of the programme was the presentation of reviews of progress on selected subjects by specialists. Rao Bahadur Prof. B. Venkatesachar gave a brief review of recent advances in "Nuclear Physics"; Rao Bahadur B. Viswanath on "Some Physical and Chemical Considerations on Plant Nutrition and Growth," Dr. C. V. Natarajan on "Mutations of Bacteria" and Dr. B. L. Manjunath on "The Chemistry of Vitamins". Two public lectures, one on "Rice Work in Madras" by Mr. K. Ramiah and the other on "Optical Technology" by Prof. H. P. Waran, were also arranged.

By the kind courtesy of the Director of Agriculture in Mysore and the President of the Mysore Sugar Factory, Ltd., a visit was arranged to the Mysore Government Cane Farms and Sugar Factory.

Sir Venkata and Lady Raman were at home to the delegates and this concluded a very successful Easter Congress.

A special meeting was also convened during the session to discuss the question of the All-India Academy of Science.

* * *

Madras Branch of the Indian Chemical Society.—The annual meeting was held on the 31st March under the Presidency of Dr. Gilbert J. Fowler. Rao Bahadur B. Viswanath was elected President and Dr. B. Sanjiva Rao, Vice-President. Dr. M. K. Aswathnarain Rao was elected Honorary Secretary.

* * *

Dye Research in Bombay University.—The laboratories of the newly started Department of Chemical Technology are now being equipped for studying the chemistry of dyes, and their optical and physical properties. The work that will be undertaken in the Department will have a special bearing on the problems of the Bombay Textile Industry. The equipment will also include a semi-works scale bleaching plant, a calico printing room and a dye house. On the Chemical Engineering side it is proposed to install small-scale chemical manufacturing plant of various types.

* * *

Appointments in the Bombay University.—We understand that the Senate of the Bombay University has resolved to make the following appointments in the newly established Department of Technology. Reader in Dyeing and Printing, Reader in Chemical Engineering, Lecturer in Experimental Dyeing, Lecturer in Industrial and Tinctorial Chemistry and Lecturer in Fuel Technology. The Senate have also decided to institute Diploma Courses in Soap Making, Paints and Varnishes, Dyeing, Printing and Finishing, Leather Tanning and Printing and Lithography. (*Chemical Age*, Feb. 24, 1934.)

* * *

An Electrical Apparatus serving the three-fold purpose of measuring Hydrogen-ion concentration, detecting the degree of corrosion on metallic surfaces and carrying out potentiometric titrations, is described in the *Chemiker Zeitung*, March 7.

* * *

T. A. Kramossilsky-Maximiov has observed that the introduction of animal harmones such as Insulin, Prolan and Ovarin into the endosperm of the germinating seeds of oats, induces an enhanced vegetative growth in plants, with a corresponding retardation of the reproductive phase (*Bull. Appl. Bot. Gen. Plant Breeding*, III Series, No. 3, 161, 1933).

* * *

Paper from Flowering Bamboos.—Mr. C. G. Trevor, C.I.E., I.F.S., Inspector-General of Forests, Dehra Dun, writes that while the experiments on flowered and unflowered bamboos (*Dendrocalamus strictus*) carried out by Mr. M. P. Bhargava, Officer-in-Charge, Paper Pulp Section, Dehra Dun, at the request of the Government of H. E. H. the Nizam of Hyderabad (and not by Mr. Khaja Nizamuddin as previously reported) show that flowered bamboo is suitable for paper manufacture, it is too early to make a general statement, until the results are confirmed by further experiments with bamboos from other areas and other species. Further, the fact that flowered bamboos can be utilised for paper manufacture is not the only or the most important factor in dispelling the fear regarding the interruption of supplies of raw materials during the period when a bamboo forest flowers. Generally speaking, the gregarious flowering of a species of bamboos occurs like an epidemic wave beginning at one edge of an area and proceeding across it in 5 to 12 years' time. The period required for the establishment of the new crop from the seedling stage, coincides with the above period, so that, by the time the last patches in a given area flower, the new crop in those areas which flowered first is fully established. Thus the flowering of bamboos does not generally jeopardise the continuity of a supply of raw material. Should, however, the new crop prove insufficient for some time for the requirements of a mill, the flowered bamboos can be utilised to fill up the gap. The knowledge that flowered bamboos can be utilised for paper making, therefore, helps to make it certain that the flowering of bamboos is not likely to menace the continuity of supply of raw material to a mill.

* * *

The Reducing Action of Lignin.—Mr. P. B. Sarkar, Chemical Laboratory, Dacca University, writes :—

Lignins from various sources have, almost without exception, been found to reduce Fehling's solution. This has been attributed to a CHO-group and provision has been made for it in the constitutional formula of lignin proposed by different investigators from time to time. There is a di-oxy-methylene group as well in the lignin molecule, which, as a rule, suffers decomposition to a greater or less extent, depending on the method of isolation. The two phenolic (OH) groups in the ortho-position which thus result, have now been found responsible for the reducing action. It is thus possible to separate the jute-lignin (obtained by 42% HCl at 20° for 24 hours) into two fractions by repeated treatment with dilute NaOH at room temperature until the washings are colourless. The soluble fraction reduces Fehling's solution readily and liberates silver from ammoniacal solution of silver nitrate just like protocatechuic acid or pyrocatechol, while the insoluble one shows no reducing property at all.

The higher the temperature and the longer the time of exposure to the acid, the less has been found the percentage of formaldehyde in the separated lignin, and the greater the reducing action as well. It is therefore quite unnecessary to assume the presence of an aldehyde group to explain the reducing property of lignin.

* * *

Prizes for the Encouragement of Publication of Modern Works in Dravidian Languages.—According to a notification from the Registrar of the University of Madras, dated 6th April 1934, prizes of the value of not less than Rs. 750 each will be awarded by the Syndicate in January 1937, for the best works in any or all of the Dravidian Languages—Tamil, Telugu, Malayalam and Kanarese—on any of the following subjects :—

Electricity.	Hygiene and Public Health.
Plant Life.	
Motors and Motor Transport.	Rural Reconstruction.
	Physiology.

Competitors for the prizes should submit six copies of each of their works, so as to be received by the Registrar *not later than the 1st October 1936. Only complete works printed and published at least six clear months in advance of the date of award will be taken into consideration.* In awarding the prize, the printing and get-up of the works will also be taken into consideration. *Works by joint authors (say a scientist and a specialist in a language) will be accepted for the prizes.*

The prizes will be awarded ordinarily to persons who are natives or domiciled in the areas within the jurisdiction of the Madras University. Competitors should, therefore, forward with their works, evidence of their domicile.

The competitor should also certify that the work submitted by him has not previously formed the basis for the award of any prize or title.

The Syndicate may divide the prizes among works of equal merit or decline to award the prizes on the ground that none of the works submitted reaches the proper standard of merit.

* * *

We acknowledge with thanks the receipt of the following :—

"Nature," Vol. 133, Nos. 3354 to 3358.

"The Chemical Age," Vol. 30, Nos. 763 to 767.

"Canadian Journal of Research," Vol. 10, No. 1.

"The Journal of Chemical Physics," Vol. 2, Nos. 2 and 3.

"The Biochemical Journal," Vol. 27, No. 6.

"Berichte Der Deutschen Chemischen Gesselschaft," Vol. 67, Nos. 2 and 3.

"Journal of Agricultural Research," Vol. 47, No. 10.

"Experiment Station Record," Vol. 70, Nos. 1 and 2.

"American Journal of Botany," Vol. 21, Nos. 2 and 3.

"Journal de Chemie Physique," Tome 30, No. 10 and Tome 30, No. 1.
"The Review of Scientific Instruments," Vol. 5, No. 2.
"The Mathematics Student," Vol. 1, No. 4.
"Scientific Indian," Vol. 11, No. 62.
"Indian Forester," Vol. 60, No. 3, and Index to Vol. 59.
"Medico-surgical Suggestions," Vol. 3, No. 2.
"Electrotechnics," No. 7, March 1934.
"Archiv fur Zoologie," Band 25, Hafte 4 and Band 26, Haftes 1 and 2.
"Forschungen Und Fortschritte," Jahrgang 10, Nos. 6 to 8.
"Indian Journal of Physics," Vol. 8, No. 3.
"Transactions of the Mining and Geological Institute of India," Vol. 29, Part 1 and List of Members for 1933-34.
"Journal of the Russian Chemical Society," LXV, Tom III, Bb III, 7 and 8.
Annual Report of the Imperial Council of Agricultural Research for 1932-33.
"Indian Forest Records," Vol. 19, Parts IV, VI and VIII.
"The Nagpur Agricultural College Magazine," Vol. 8, No. 3.
"The Indian Trade Journal," Vol. CXII, Nos. 1445 to 1448.
"Monthly Statistics of the Production of Certain Selected Industries of India," No. 10 of 1933-34.

Reviews.

ELEMENTARY CHEMICAL THEORY AND PROBLEMS. By N. M. Shah. (Published by the Karnataka Printing Works, Dharwar. Pages 145.) Price Re. 1.

The author claims that a special feature of the book is that every chapter is introduced with a clear and complete account of the main principles involved in its subject-matter. But the explanation of the theoretical principles seems to lack in rigour and thoroughness. Considering that the book is meant to satisfy the advanced needs of the I.Sc. students, the details regarding estimations of elements in organic compounds seem to be superfluous. A number of examples have, however, been completely worked out in each chapter and the various steps are well explained. Further a large number of exercises have been given at the end of every chapter. The get-up of the book is not as good as is desirable.

M. SESHAIYENGAR.

* * *

SEX AND SEX ETHICS. By Rene Guyon. Translated from the French by J. C. and Ingeborg Flugel with an Introduction by Norman Haire. (The International Library of Psychology and Sexology. John Lane, The Bodley Head Limited, London, 1933.) Price 15s. net.

The sale of this book is limited to certain professions and research students. We do not know whether official censorship has imposed this restriction. We can, however, discover nothing in the book which may be presumed to offend the public sentiment of decency and morals; rather a perusal of it is, in our judgment, calculated to elevate and strengthen them.

Undoubtedly the book is a notable contribution to sexological literature, absolutely pure and scientific in the exposition of the several aspects of the sex problem, catholic and courageous in outlook and logically correct in conclusions regarding the various codes of sexual morality. The author is an advanced rationalist whose judgments are unfettered by the conventional shackles of religion which surround our sexual ethics. Few can brush aside the hard shell of prejudice and convention which are believed to secure the stability of society and can examine the sexual phenomena and morality in a strictly detached scientific spirit and subject the various forms of sexual self-expression popularly known as aberrant to philosophical or logical criticism. Conventional modes of thinking and social prejudices die hard and people brought up on the milk of religious traditions have no patience with any attempt, however necessary, to revise our old sexual conventions. Sexuality under the sanction of the duly appointed priests and with the official approval of parents, is recognised by law, praised by society and exalted by religion but its manifestation outside this formal limit or in any altered form is condemned by bell, book and candle.

Commencing with the study of sexuality from an historical and phylogenetic standpoint, the author arrives at certain conclusions regarding sexual responsibility, modesty and the justifiability of certain taboos concerning certain acts and bodily organs. It is extremely doubtful whether public opinion will approve of the author's views about chastity and its exaltation as a virtue by moralists, but his penetrating study

of the question is entitled to praise. According to him the usually accepted conception of normal and abnormal sex life is really based on a want of proper appreciation of the natural modes of its expression in infancy. It is true that from a physiological standpoint, the pleasurable sensation due to excitement is subordinate to the more fundamental function of procreation, but it is for procuring the former that lives are sacrificed. The author takes what might appear an ultra radical, but really the only possible view of the theory of psychoanalysis, *viz.*, the sexual ethics which is faulty must be revised rather than the patient should be taught to adapt himself to an irrational system. He examines certain "extraordinary" practices such as onanism, incest, homosexuality and comes to the conclusion that they are neither "abnormal" nor "sinful". The subject of "love" expounded in the penultimate chapter of the book is brilliantly analysed and the author preferring to call it "individual love" condemns its exaltation at the expense of other forms of sex manifestation.

Sex problem is hardly yet regarded as a vital public question and the prevailing opinion is that it is best left alone. There is an element of apprehension that the public discussion of what is avowedly looked upon as a delicate and private subject will stimulate endless curiosity and probably may lead the younger men and women into devious paths. Society as it is at present constituted is based on conventions and if the latter were to be upset, the whole structure of the former is likely to crumble. It seems to us that the proper attitude of the public to the sex problem should be to remove the unmerited foolish shame which surrounds it and treat it with no more delicacy than any scientific topic is dealt with. The progress of knowledge implies continuous revision of views generally accepted as inviolable and if old mouldered code of morality is to be replaced by a new dispensation, society should have sufficient resource to readjust itself to the new spirit and the teachings of science. The book delivers the new message, which is ultimately bound to be accepted as an article of scientific humanism.

The book is admirable. If the author needs courage to expound his doctrines, the reader requires more courage to read them. We do not anticipate that the book will be welcomed by the intellectually timid and the sacerdotal section of the people but that this new code of sexual ethics will eventually become the creed of reformed society of the future, few will doubt.

* * *

MAN AND WOMAN IN MARRIAGE. By C. B. S. Evans, M.D., F.A.M.A., with an Introduction by Rudolph W. Holmes, M.D., F.A.C.S., and a Preface by Norman Haire, Ch.M., M.B. (The International Library of Psychology and Sexology. John Lane, The Bodley Head Limited, London, 1933.) Price 5*s*. net.

Judging by the advertised articles, the requirements of modern civilised man (and woman also) are bewilderingly varied and numerous. In fact from the date of his or her birth, the needs of the individual for a "happy and fashionable life" are carefully thought out and sold at "moderate price". Misshapen parts of human body can be rendered handsome at a small cost, those that are deficiently formed or are lacking can be made full or are supplied for a trifling consideration. The skin is treated, the brain is trained, the limbs are made strong, the bath is medicated, the food is supplied in tins of vitamins, the hair converted into any desired colour and curls, the nose may be grown to the fashionable size and straightness and all the internal viscera and endoskeleton can be adjusted to carry out their proper physiological functions and as for toilet and articles of dress, one has to look into the advertisement pages of any popular magazine to be convinced that they are not so simple as might be imagined. The make up of a society woman is manifestly an elaborate and tedious affair and if cleverly carried out, will cover up any natural defect. Frequently it happens that a steady resort to artificial means of improving looks which do not require any adventitious aids, may result in worsening them and a continuous application of irritating or "soothening" chemical preparations instead of improving might produce undesirable effects in the long run. Perhaps the safest thing is to rest content with what nature has endowed us with and carry our face and features as God made them.

We are puzzled to be told that men and women require advice as regards the facts of their married life. This department of life, we had thought, was too intimate and natural to be made the subject of public discussion. It is true that it has now become most unfortunately necessary to educate the public on marriage or sex hygiene but this can be imparted to the young men either as

a course of instruction in science in the schools and colleges or as part of the University Extension Lectures or the information may be given through a series of illuminating articles in the newspapers. The conditions of modern life have introduced dire sex diseases whose spread and ravages must be combated by every means at our disposal. It is, however, surprising to be told that a large number of men and women are in need of instruction in the performance of the most natural and instinctive functions to the satisfaction of the parties concerned. Drugs which are alleged to improve and strengthen the exercise of these functions and books which purport to give advice on them must be popular at all times among the neurotically disposed persons.

We have read this book with considerable amusement. Obviously the modern educated man and woman need instruction and advice on matters which their less favoured brethren and sisters can manage without books and drugs. According to the testimony of the author, there are several thousands of persons whose married life can be rendered happy by timely and hourly advice and who without it are apt to lead a sexually starved existence. We have every reason to regard this statement as substantially true and in every such case, the advice given in the book will be found competent, wholesome and satisfactory. Perhaps over-education renders people over-nervous and the nervous energy primarily intended for procreative purposes, if prematurely expended in enriching the mind, must result in an impoverishment of the rest of the body.

The book gives excellent advice to people who require it. To write such a book may be an act of public service. But a greater and more enduring service to humanity would be to investigate and remove the causes which lead men and women to accept such advice. It seems to us that the false shame which surrounds the subject of sex and which is so productive of evils, must be one of those causes and if it were so, the remedy is obvious. Young men ought to receive as a part of their education instruction as regards the biological import of sex life, its intentions and implications from the sociological and philosophical standpoint, with due emphasis on its practical and hygienic aspects. Under the influence of modern excitement, young men are apt to forget that their sense of self-respect and their instincts of personal dignity demand conservation of nervous energy which like worldly treasure should be augmented rather than extravagantly expended. The road to its enrichment is a simple and God-fearing life. If you cannot walk on this path, then read and profit by Dr. Evans' book on *Man and Woman in Marriage*.

* * *

EIGHTEEN YEARS ON LAKE BANGWEULU. By J. E. Hughes with an Introduction by Major H. C. Maydon. (Published by the Field House, Bream's Buildings, E.C.4, London.)

The author says that "the writing of this book has been a tougher task than stopping a charging buffalo". This does not appear to be the experience of most modern writers and the general reader might be tempted at certain moments to wish that these authors also found at least occasionally that it was so with them. The book is an excellent contribution to our knowledge of the Geography of that portion of Africa between Belgian Congo and North-East Rhodesia and its interest is not confined to sportsmen alone. The picture of the country with its lakes, rivers, mountains, marshes, forests and wild game together with a description of the native inhabitants, their manners, customs, habits, dwellings, dress, food and social organisation and powers of educability, has an irresistible attraction and we confess that we have read the book with great pleasure and profit.

Geography teaching in the schools has no doubt undergone within recent times a considerable change, but still there is pathetic adherence to the practice of memorising details of produce of countries, lists of the names of towns and the pupils generally fail to develop a mental picture of the country as a whole. It is not uncommon to find among even highly cultivated people, instances of gross ignorance of simple, elementary geographical facts and few among the educationalists realise that the proper and efficient teaching of Geography entails a deep knowledge of cultural and physical Anthropology, Ethnography, Geomorphology, Climatology, Biology and the physical sciences. It may be true that we may not find at the present moment teachers possessing such an ideal equipment, but if the subject is to be taught in all its scientific bearings and human significance, then it is manifest that we have to take measures for providing our teachers of Geography with the necessary training in all the collateral

branches of knowledge. In certain provinces of India, Geography is a neglected field, being made an optional study in the high school curriculum. We are not quite sure whether this sort of educational reform is an indication of wisdom. It is impossible to follow a modern newspaper without an adequate knowledge of the World Geography and we do not sufficiently appreciate that the geographical facts lend themselves to be treated from the scientific and human standpoints and as an instrument of education, its power and influence are far superior to any of the subjects which form the core of compulsory studies.

The chief merit of the book is that its chapters provide independent topics for study and one may commence from any chapter and obtain a vivid picture of a portion of the extensive territory forming the subject-matter of the book. We have ourselves followed the usual practice of reading books and every page has an account either of a thrilling encounter with some one or other of the big game, or village life, river system, picnic party, crocodile hunt, seasons and climate, fauna and flora of the plains and mountains or the geological formation of the different areas. The observations recorded in the book have a great value to the scientist and the explorer and the notes given in the appendix provide equally interesting reading. We have here a good book, written in simple and elegant style, vividly portraying everything worth knowing about Central Africa and forming a valuable contribution to the Geographical literature. We are tempted to suggest that everyone wishing to have a closer acquaintance with this interesting continent and more especially teachers of Geography must possess a copy of this book.

After reading the book, we cannot refrain from feeling that the destructive activities of the sportsman must eventually result in the upsetting of the balance of nature much to human detriment. The indiscriminate slaughter of animals having scientific and economic interest, must necessarily produce repercussions whose consequences we may not foresee at present, but undoubtedly are bound to be deep and far-reaching. Is it humane or necessary to go so far afield to kill animals and seek pleasure in their death agonies?

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LES FONDEMENTS DE LA THEORIE DE LA RELATIVITE GENERALE; THEORIE UNITAIRE DE LA GRAVITATION ET DE L'ELECTRICITE; SUR LA STRUCTURE COSMOLOGIQUE DE L'ESPACE. Par Albert Einstein; Traduit de l'allemend par Maurice Solovine. (Paris: Hermann et Cie, 1933.) Prix 35 fr. broché.

The brochure is a collection of three papers by Einstein translated into French by Maurice Solovine. The first of these papers is the classical one of 1916 on the General Theory of Relativity. The second is the work of Einstein and Mayer containing the new unified theory of Electricity and Gravitation, based on the five dimensional theory of Kaluza and communicated to the Berlin Academy in 1931. The third is the translation of an article contributed in September 1932, giving a summary of the ideas that led to the theory of the Expanding Universe and showing that there is no reason to suppose that space is curved. The importance of these papers needs no new mention and the publishers must be congratulated on making them available to a larger public. The elegance and clarity of the French language have made every one acquainted with it wish for and welcome a translation into it of any abstruse disquisition. We are sure that the translation will find a large circle of grateful readers, who will also be delighted to find a good portrait of Prof. Einstein at the beginning of the book.

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